TECHNOLOGY DEPT.

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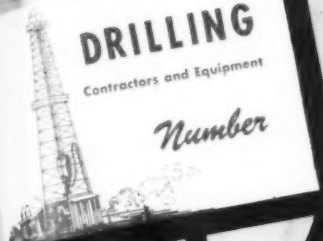
1950
DETROIT



OIL AND GAS JOURNAL

Moving your rig into new territory?

ONE OF THE FIRST persons you'll want to talk to is the Hughes man. He knows the type of rock bits which have made the best footage in the various formations you'll be running in. The Hughes service organization is the only one which covers *consistently* all of the active oil fields in the U. S. and Canada wherever rotary drilling is done.

There were more than two thousand rigs running in this area last year and practically every one was contacted at least twice a week by a Hughes field man! Hughes field representatives drove over eight million miles last year to make this record possible!

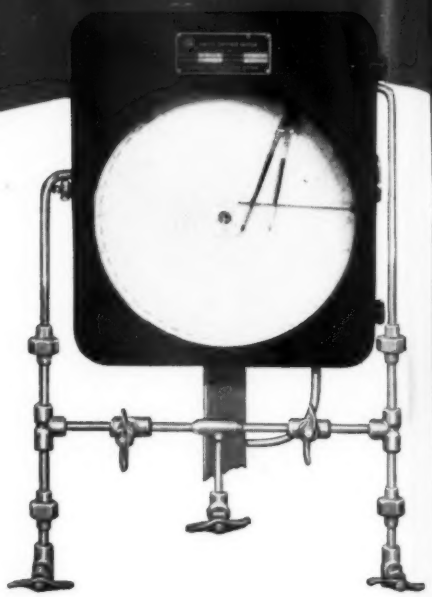
The Hughes men visit more rigs more times. That is the reason Hughes knowledge of special drilling conditions and rock-bit development in the field leads all competitors. This knowledge is available to you, of course, at any time. We invite you to make use of it.

PRICE 50 CENTS TABLE OF CONTENTS PAGE 111 OCTOBER 5, 1950

XUM

NEW!

LEAKPROOF STUFFING BOX
Requires No Lubricant



STUFFING BOX FEATURES

The heart of this unit is a combination packing and bearing made of synthetic Teflon. This material is tough, chemically resistant, stands up to 450° F., has a low coefficient of friction. It flows slightly under extreme pressures. Spring loaded follower serves as a pilot to adjust bearing to contours of body and periphery of shaft —seals tight with minimum friction. All other parts are made of stainless steel. Shaft and Teflon bearing may be replaced in the field.

EXCLUSIVE IN ROCKWELL-EMCO
ORIFICE METERS

Now it can be told! For well over a year the new Rockwell stuffing box has been field tested by major pipeline companies and cycling plants on all kinds of gases and pressures. Performance has been outstanding! At one of these cycling plants the new stuffing box is working at flow temperatures of 200° F. and pressures of from 3600 to 4000 psi. Factory tests of this design, *without lubricant,* show absolutely no leakage handling nitrogen at high pressure and free rotation of the shaft under a *torque of only 9.7 inch-grams.* So successful is the new stuffing box that its use is now standard on both high and low pressure Rockwell-Emco orifice meters. Packaged kits for converting meters in service are available. Write for full details.

THE ROCKWELL-EMCO INTEGRATOR

The charts from many high pressure meters represent several thousand dollars. Hence accuracy in chart calculation is imperative. The operator of a Rockwell-Emco integrator mechanically computes charts by simply tracing the pressure and differential records made by the meter. The total extension then appears on a direct reading counter, accurate to ½ of 1 per cent or closer.

ROCKWELL MANUFACTURING COMPANY

Pittsburgh 8, Pa.

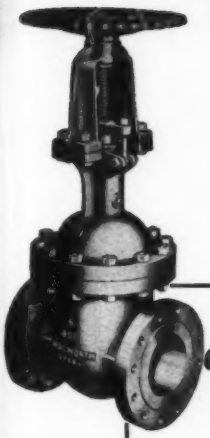
Atlanta · Boston · Chicago · Dallas · Houston · Kansas City · Los Angeles
New York · Pittsburgh · San Francisco · Seattle · Tulsa

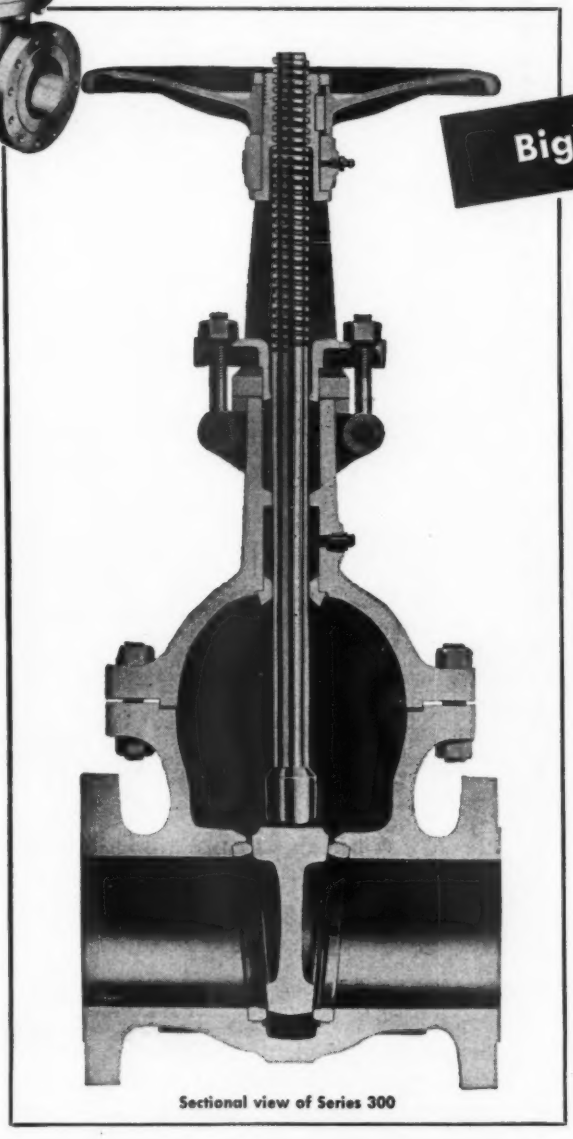
WALWORTH

Cast Steel Gate Valves

Series 150 and 300

Wedge Gate — Outside Screw and Yoke





Sectional view of Series 300

Big 8-Point Superiority!

Gland clearances are such that stem cannot be scored if gland should be tightened unevenly.

Deep Stuffing Boxes in all sizes (2" to 24") insure tightness and maximum packing life — costly leaks are eliminated.

Bonnets and Bodies are engineered to withstand pressure and minimize distortion — they're tough, durable, dependable.

Heavy Steel Walls provide extra strength and longer life.

Integral Body Guide Rib Faces are machined to insure accurate disc seating.

Seat Rings are bottom seated — not flange type. No recess exists at back of ring — hence no turbulence, erosion, or pressure drop.

Streamlined Ports allow high velocity, non-turbulent flow, and reduce the possibility of erosion.

Valves regularly have flanged ends. They can be supplied with ends for butt welding. Roller bearing yokes are available. On valves 5 inches and larger, by-passes can be furnished.

For Series 600 and higher, we recommend Walworth Pressure-Seal Steel Gate Valves.

For further information on Walworth Cast Steel Gate Valves, see your local Walworth distributor, or write:

WALWORTH

valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

The Oil and Gas Journal, published Thursdays by The Petroleum Publishing Company. Entered as second-class matter September 1, 1910, at post office at Tulsa, Okla., under act of March 3, 1879. U. S. and foreign rates to the petroleum industry, $3 yearly. Copyright 1950.

XUM

Sweet Operation in a Sour Situation!

Even we were surprised at the record hung up by the Fairbanks-Morse ZC Engine on this job. Operating on by-product natural gas with a hydrogen sulphite content in excess of 40 per cent . . . a sour-gas content *six times as high* as all previous notions of the allowable maximum . . . it's been running sweetly for almost two years.

It's typical of the ability of the ZC to keep going under the toughest of operating conditions . . . to operate efficiently and economically. Check your supply store for the ZC record or write Fairbanks, Morse & Co., Chicago 5, Ill.

FAIRBANKS-MORSE,

a name worth remembering

OIL FIELD EQUIPMENT • DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY • PUMPS • SCALES • HOME WATER SERVICE AND HEATING EQUIPMENT • RAIL CARS • FARM MACHINERY

XUM

When the Chips are Down

Count on

GUIBERSON TYPE "J" ROTATING DRILLING HEAD

Reversing dollars out of the hole? Yes—very seriously, there is a great saving to be had on many wells by using *reverse circulation.* The Guiberson "J" Head not only gives the ultimate in reverse circulation performance, but is a packed off rotary table with both kelly drive and tubing slip mechanism integral. This is incorporated in one short assembly. The fact that circulation can be in either direction at will is particularly advantageous when the operator is alternately drilling and washing a production zone. Kelly pack-off rubber turns with kelly for an effective pack-off with longer life.

Type "J" Rotary Head
With revolutionary full floating wash pipe assembly—an exclusive Guiberson feature that doubles wash pipe packing life. Assembly rotates freely and without leakage —easily and quickly replaceable.

SAFE THAN SORRY — UIBERSON — BETTER BE

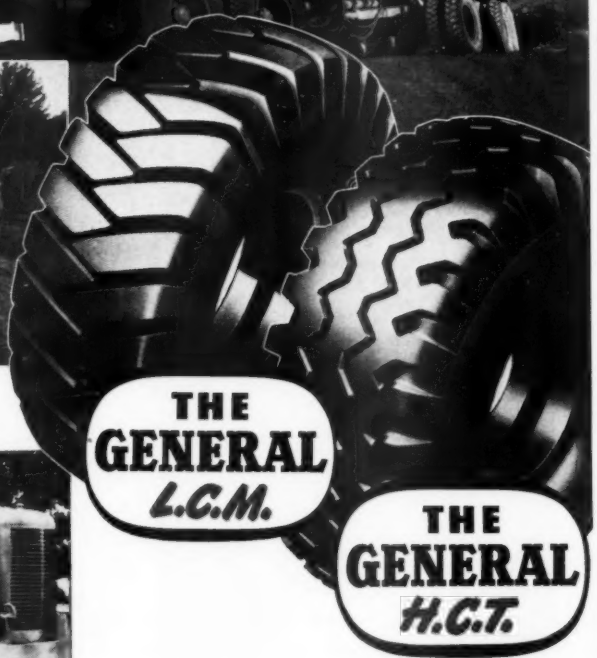
SOLD BY LEADING OIL FIELD SUPPLY STORES EVERYWHERE

Established 1919 — THE GUIBERSON CORPORATION — Dallas, Texas U. S. A.

Building Pipelines . . . Transporting Power Units . . .
Moving Tank Cars— **GENERAL**
GETS ALL JOBS DONE
FASTER! SAFER! CHEAPER!

Off-the-road jobs require the extra strength and traction the General L. C. M. gives. No slipping, sliding, spinning. Massive lugs of rubber form a self-cleaning, open-center tread.

Over-the-highway, the General H. C. T.'s broad, free-rolling tread ribs put more rubber on the road for more safety, even wear, quicker stops on dry or wet pavement.



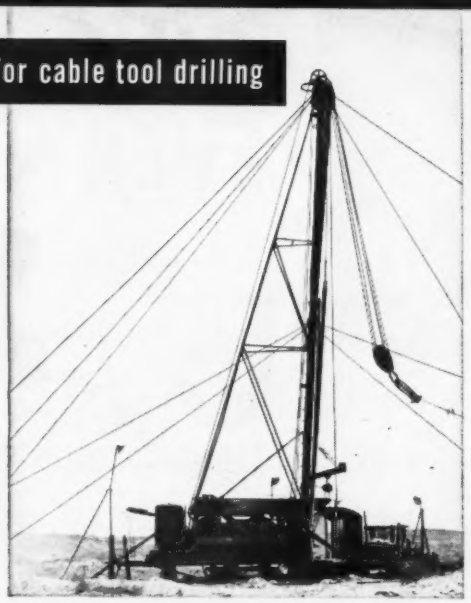
When jobs call for off and on-the-road work you can make more profit on General's dual-purpose team. The General L. C. M. gives you more traction, more flotation, more strength and wear for most work off-the-road. The General H. C. T.'s deep, saw-tooth, free-rolling tread ribs run safely at high speed over-the-highway. More rubber for more original miles. More carcass strength for more recap miles.

SPECIFY GENERAL TIRES ON YOUR NEW EQUIPMENT

There's a Macwhyte rope that's the right rope . . .

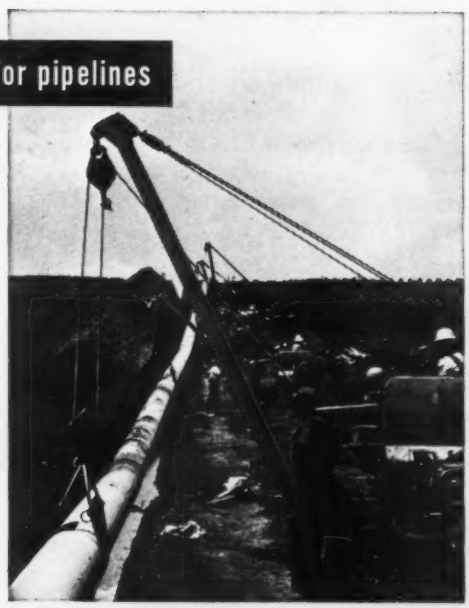
For rotary drilling

For cable tool drilling



For well servicing

For pipelines



A thousand and one
WIRE ROPES
made by
MACWHYTE,
all job-proved. . .

Because your equipment is designed specially for the work you are doing, you'll get the best service by using wire rope *specially designed* for your equipment.

From the thousand and one wire ropes made by Macwhyte, you're sure to get the wire line specially designed for and suited to your needs.

The specialized experience of Macwhyte engineers is yours for the asking—to get recommendations for all your needs, just call a Macwhyte distributor or write Macwhyte Company.

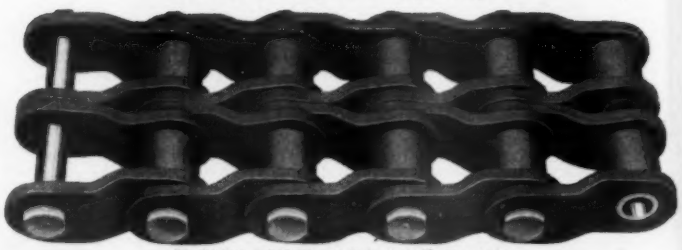
MACWHYTE COMPANY, 2916 Fourteenth Avenue, Kenosha, Wisconsin. Manufacturers of Monarch Whyte Strand PREformed, Internally Lubricated Wire Rope, Atlas Braided Wire Rope Slings, Aircraft Cables and Assemblies, Monel Metal and Stainless Steel Wire Rope. Mill Depots: New York • Pittsburgh • Chicago • Minneapolis • Fort Worth • Portland • Seattle • San Francisco • Los Angeles. Catalog on request.

985-O

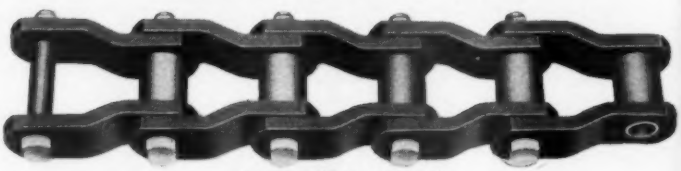
there's a LINK-BELT Oil Country Chain for EVERY DRILLING JOB!

Link-Belt's line of oil country chains offers the operator a chain for every drilling service, regardless of depth or load. The wide margin of preference in the industry for Link-Belt chains is the result of smooth running, trouble-free performance through many years of service.

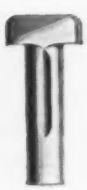
SS-3125 HYPER, A.P.I. 3⅛" Single



SS-3125 HYPER, A.P.I. 3⅛" Double

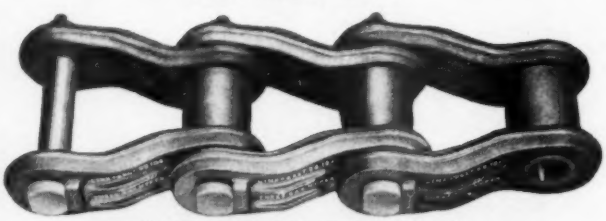


SS-40 HYPER, A.P.I. 3



Left: All pins in Link-Belt Oil Drilling Chains are furnished with the patented grooved shank oil country cotters which hold the pin securely, but are easy to insert or remove.

Below: Dust proof fibre boxes mean handling convenience and keep chain free from dirt, grit, abrasive matter, rust and corrosion. Boxes labeled for identification.



SS-124 THREE BAR HYPER, A.P.I. 4

A.P.I. 4 SUPER HYPER PRECISION CHAIN

LINK-BELT COMPANY

Indianapolis 6, Dallas 1, Houston 1, Kansas City 8, Mo., Los Angeles 33, New York 7, Toronto 8.
Distributors in All Fields. 11,884

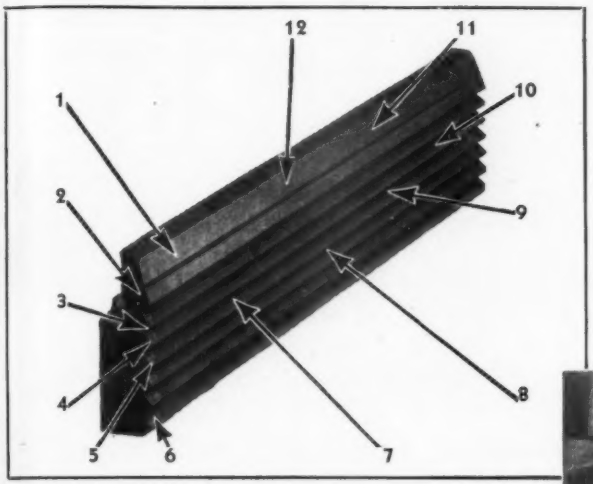
LINK-BELT

CHAINS AND SPROCKETS

A Type for Every OIL INDUSTRY SERVICE

The LANDIS CHASER

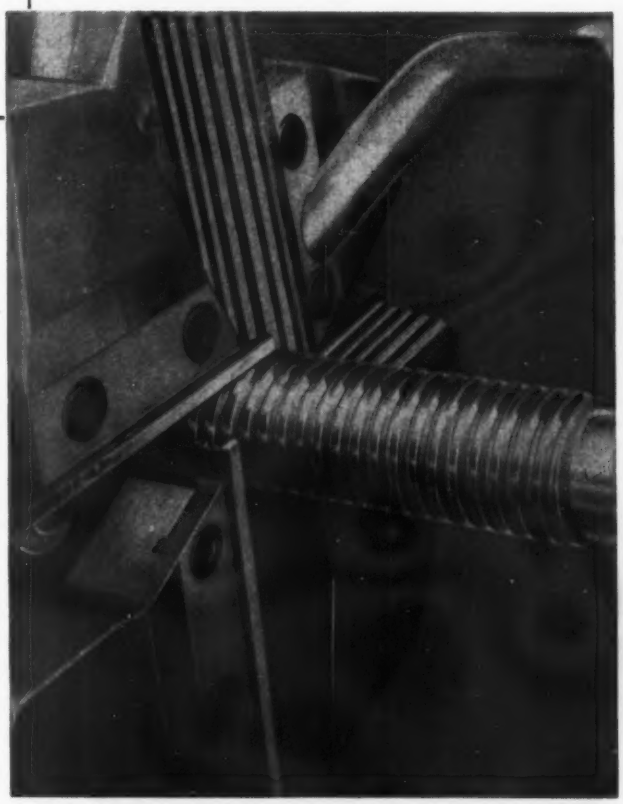
The Finest Thread-Cutting Tool in Industry



. . . SAVES TIME AND MONEY IN MAINTENANCE AND PRODUCTION

Important features are built into the basic design of the Landis Tangential Chaser and bring large returns in cost saving, increased output, and improved product quality both on the production line and in the maintenance shop.

1. PERMANENT THROAT permits close-to-shoulder threading throughout the life of the chasers.
2. RAKE ANGLE RANGE may be varied from 5° negative to 35° positive to permit a suitable cutting angle for each machinable material.
3. FREE CUTTING condition is the result of the tangent position of the chaser to the workpiece and allows the highest cutting speeds.
4. EASILY REGROUND by a simple grinding operation that renews the entire cutting edge and leading feature and retains the initial accuracy of the chaser.
5. LINE CONTACT during thread cutting between the chaser and the workpiece lessens friction and minimizes thread distortion.
6. LEADING FEATURE insures thread of accurate lead —this feature is not destroyed by regrinding and thus the chasers continue to produce threads of accurate pitch after regrinding.
7. LATERAL ABSORPTION of cutting strains due to the tangential position of the chaser reduces friction and vibration, thus reduces wear and breakage and makes the chasers last longer.
8. RIGHT- AND LEFT-HAND threads may be cut with the same chasers by grinding both ends of the chaser, using appropriate holders, and changing the spring in the die head.
9. ALL DIAMETERS of threads with the same pitch and form may be cut with the same chasers using appropriate holders.
10. INTERCHANGEABLE chasers reduce tool cost and tool inventory by allowing chasers to be reground or replaced individually without affecting other chasers in the set.
11. CHASER LENGTH provides low tool cost and long life, since chasers may be reground to 80% of their length and retain initial accuracy of pitch, diameter, and depth of cut.
12. PERMANENT THROAT gives equal distribution of cut.



ABOVE: 1⅝" diameter 4 pitch right- and left-hand Acme threads are cut 5¼" long on opposite ends of vise screws in one pass using a LANDMACO Single-Head Threading Machine equipped with Leadscrew Attachment. In finishing 12.9 pieces per hour, the machine operates at a cutting speed of 24 surface feet per minute. The 4.66 minute operation formerly required 79.74 minutes.

LANDIS *Machine* COMPANY · WAYNESBORO PENNSYLVANIA

Represented *in the Domestic Oil Fields by:* Colcord-Wright Machinery & Supply Co., St. Louis, Mo.; C. J. Harter Machinery, Houston, Texas; Frederic-Baker Co., New Orleans, La.; Moore Machinery Co., Los Angeles and San Francisco, Calif.; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.

XUM

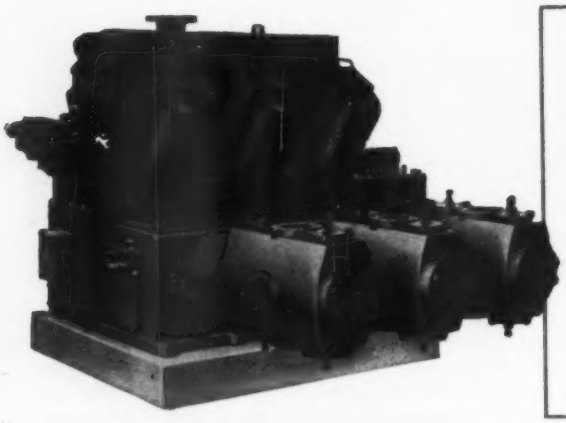
Panhandle Cuts Installation Costs with PACKAGED COMPRESSOR PLANTS

These two packaged compressor plants, installed by the Panhandle Producing & Refining Company near Agua Dulce, Texas, deliver gas to a pipe line from flare-gas collection lines and from a gas-lift system.

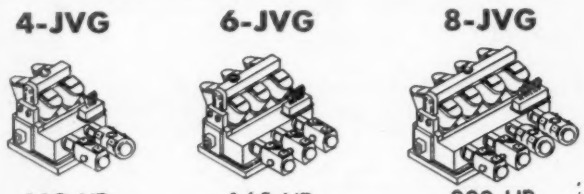
Each is a *completely self-contained unit*—with an Ingersoll-Rand 6JVG gas-engine-driven compressor; cooling system for gas, water, and oil; intake and interstage scrubbers; and all necessary manifolds, surge tanks, piping and controls.

Panhandle purchased five of these completely packaged plants from the J. B. Beaird Co., Shreveport, La. More than 100 Beaird packaged plants—all with I-R gas-engine-driven compressors ranging from 100 to 300 hp—are now in service.

built around Ingersoll-Rand JVG Gas-Engine Compressor units



The Ingersoll-Rand JVG gas-engine-driven compressor is a "natural" for packaged plants—or any other application which calls for maximum power with *minimum space and weight*, and with *good running balance*. Its 4-cycle, V-angle design gives substantial savings in fuel consumption and lubricating oil, too . . . assures smooth, efficient operation over a wide range of speeds and loads. Ask your I-R representative for complete information.



Horsepower	Width	Length	Height
110	6'-2"	8'-5"	6'-3"
165	8'-3"	8'-5"	6'-3"
220	10'-4"	8'-5"	6'-3"

Ingersoll-Rand

536-6 11 BROADWAY, NEW YORK 4, N. Y.

COMPRESSORS • AIR TOOLS • CONDENSERS • TURBO BLOWERS
ROCK DRILLS • CENTRIFUGAL PUMPS • OIL AND GAS ENGINES

Well Driller Reports:

16 wells drilled— 120,000 feet of hole—

with ONE length of Goodyear Style 3153-H Rotary Hose

THIS prominent southwestern driller used a single length of Goodyear's Style 3153-H Rotary Drilling Hose to sink sixteen wells over a 33-month period — far better service than he averaged with previously-used hoses.

Explanation for this outstanding service is that Style 3153-H Rotary Hose is designed by the G.T.M.—Goodyear Technical Man — to do a specific job longer, better, at lower cost in the long run. For this same kind of service in flat belts, V-belts, hose, molded goods, and all industrial rubber products, get in touch with your nearest Goodyear Industrial Rubber Products Distributor, or write Goodyear, Akron 16, Ohio.

GOODYEAR INDUSTRIAL RUBBER PRODUCTS
GM-Specified STREAMLINED INTEGRAL COUPLING FOR ROTARY HOSE
A—Threaded fitting draws assembly tight for positive closure
B—Smooth outer cover can't catch on rig
C—Soft, live-rubber sealing ring prevents leaks at pressures up to 5,000 lbs.
D—Integral flanged end provides full flow without need for enlarged ends, outside clamps or bands
E—Built-in wire reinforcement in hose end further strengthens fitting

FOR HOSE, FLAT BELTS, V-BELTS, MOLDED GOODS, PACKING, TANK LINING built to the world's highest standard of quality, phone your nearest Goodyear Industrial Rubber Products Distributor.

We think you'll like "THE GREATEST STORY EVER TOLD"—Every Sunday—ABC Network

GOODYEAR

THE GREATEST NAME IN RUBBER

XUM

—another reason for TOTCO on your rig

TOTCO men make the rough calls in stride... hundreds of trips into swamps, in the desert, and over boggy roads at night and in storms. Our service organization will go on making all the trips you need anytime, anywhere.

But the *values in service* to you are (1) trained men able and *willing* to help you, and (2) our responsibility to build the finest Recorder... one that will give the ultimate in trouble-free operation.

The TOTCO service organization has been building for twenty years... a long-time association with drilling requirements. You'll find TOTCO organized to gain your appreciation... because our service is based on what we've learned you want.

Technical Oil Tool Corp., Ltd.
1057 N. La Brea Ave., Los Angeles 38, Calif.

Exclusive Distributors

California—The Republic Supply Company of California
Domestic—The Continental Supply Company
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TOTCO Recorder

YOU CAN TAKE TOTCO READINGS ANYTIME

Run in and out on measuring line.

Dropped down drill pipe; picked up with core barrel overshot.

Dropped down drill pipe; recovered when bit is changed.

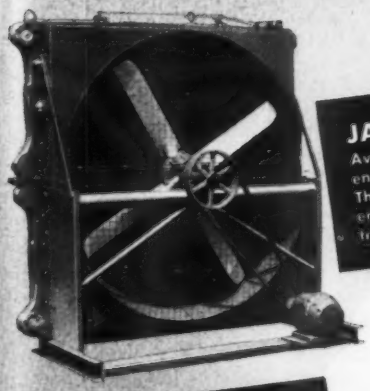
Run in the Recorder connected to a core barrel overshot when picking up a retractable core barrel.

Run in and out on ordinary sand line.

Be **SURE** *you know, use* **TOTCO**

4 WAYS TO BEAT THE HEAT!

IN OIL FIELD COOLING AND CONDENSING
WITH MANUFACTURER'S RESPONSIBILITY AS YOUR GUARANTEE



JACKET WATER COOLERS

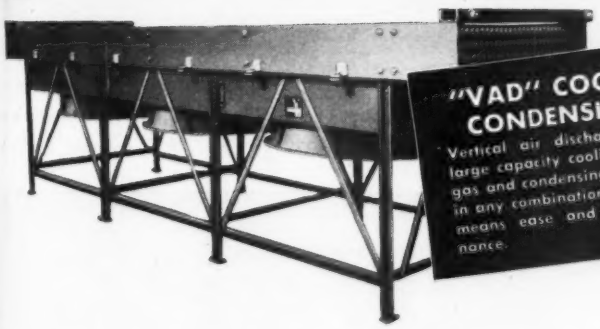
Available in a wide range of sizes for engine jacket water or lube oil cooling. These units are sturdy, compact, and engineered to provide maximum heat transfer with low hp requirement.

"HC" COOLERS

Multiple unit installations provide economical handling of water, oil or gas cooling and steam and vapor condensing in any combination. Easily installed in the field.

HEAT EXCHANGERS

Space-saving units available from stock in fixed or removable tube bundle types. For jacket water or lube oil cooling in stationary or marine (fresh and salt water) applications.



"VAD" COOLING AND CONDENSING UNITS

Vertical air discharge units for extra large capacity cooling of water, oil and gas and condensing of steam and vapor in any combination. Low-level mounting means ease and economy in maintenance.

In addition to the field-tested products shown above, Young offers: gas, gasoline and Diesel engine cooling radiators; atmospheric and evaporative coolers and condensers; supercharger intercoolers, and similar products for the Petroleum Industry. Young supplements the design engineering of its equipment with application ingenuity thereby increasing the practicability of all Young products. For example, the popular "Vertiflow" Unit Heater, has been used successfully as an economical condenser. It can also cut heating costs by using the waste heat from engine jacket water for space heating. Young *engineered* applications cost no more. Contact your nearest Young Representative for further details.

YOUNG

Heat Transfer Products for Automotive and Industrial Applications.

Young Quality

Reg. U. S. Pat. Off.

Heating, Cooling, Air Conditioning Products for Home and Industry.

YOUNG RADIATOR COMPANY

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LOUIS J. CERCONE,
Ellicott Square Bldg.
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AMERESCO, INC.
50 Church Street, Room 968
New York 7, New York

XUM

BUILT TO LICK TOUGH

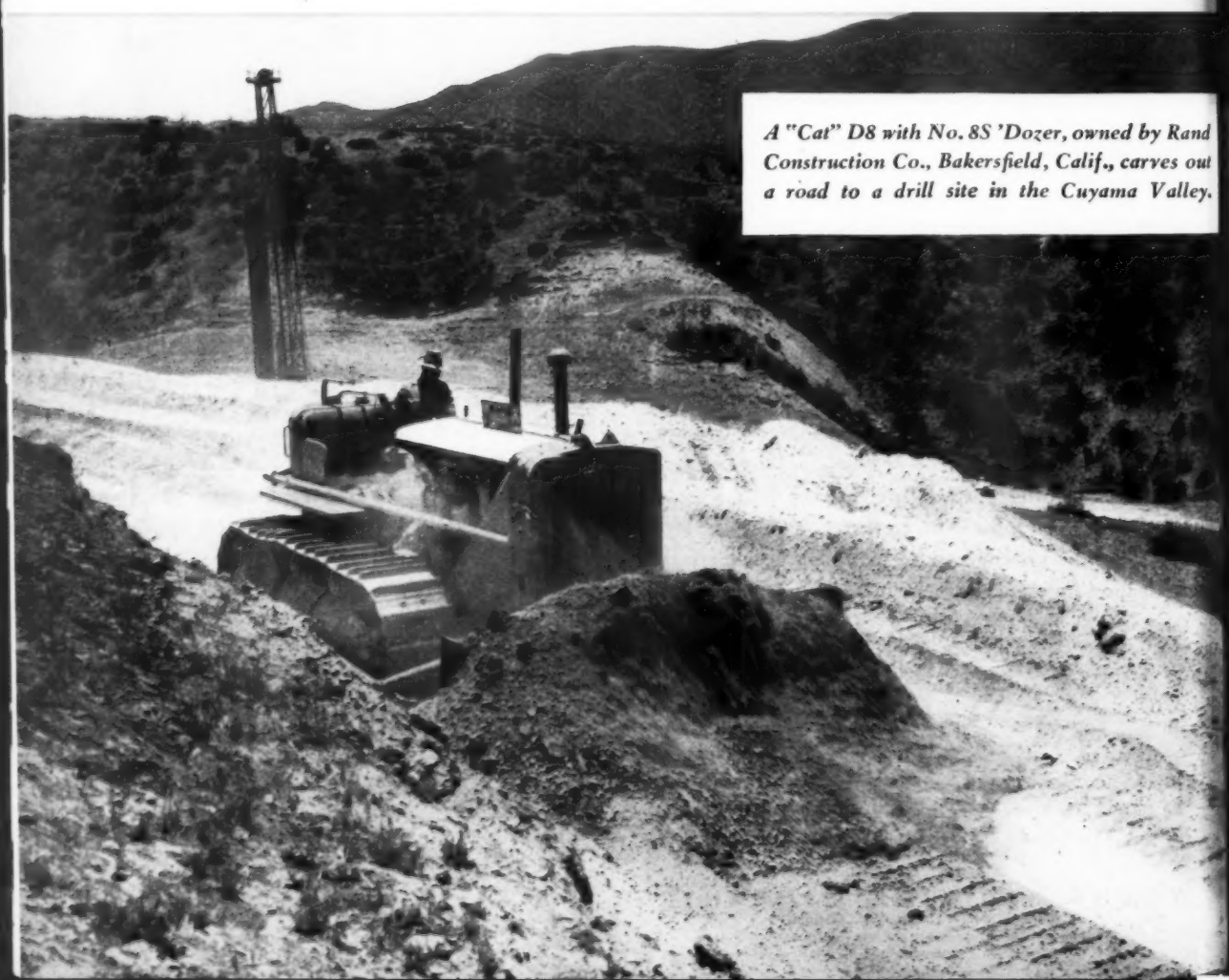
Drilling contractors and earthmoving contractors have been a strong team in the development of the oil industry . . . the men who drill and the earthmoving men whose work makes drilling possible.

Half the time the latter start from scratch – clawing their way in through country that never saw a vehicle before – battling rock, dust and frozen ground. The fact that they get the job done at all is a tribute to their skill and their rugged machines.

What's their favorite equipment? No question about it–it's "Caterpillar." "Best tractor in the business for oil-field and other rough work," says Wyman Windham, Jr., of Livingston, Texas.

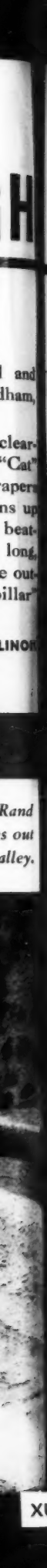
From cutting the access road and clearing the rig site to building a fire wall, "Cat" Diesel Tractors, 'Dozers and Scrapers have the power and punch that cleans up contracts fast. They're built to take a beating and ask for more. And their long, dependable work life is backed by the outstanding service offered by "Caterpillar" dealers everywhere.

CATERPILLAR TRACTOR CO. • PEORIA, ILLINOIS



A "Cat" D8 with No. 8S 'Dozer, owned by Rand Construction Co., Bakersfield, Calif., carves out a road to a drill site in the Cuyama Valley.

XUM



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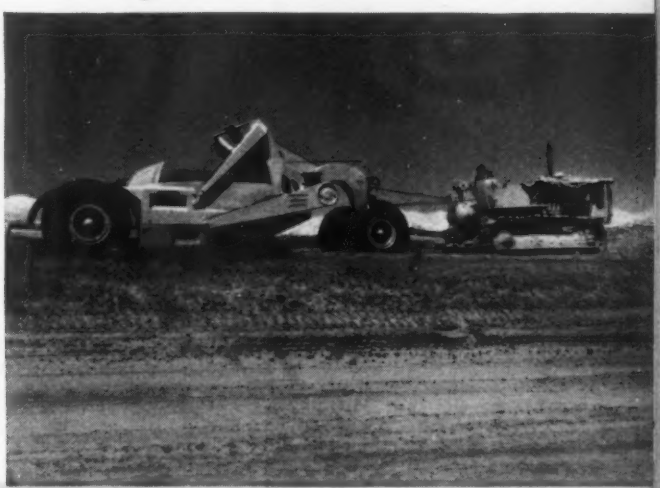
DRILL SITE JOBS

This D7, equipped with a "Cat" No. 7A hydraulic Bulldozer, is leveling a rig site in the South Liberty field. Owned by Windham & Sons, Livingston, Texas.

Frozen ground can't stop this D8 with 'dozer and rooter, as it digs mud pits and sump for a rig in Alberta, Can. Owned by Drilling Contractors, Ltd., Calgary, Alberta.

Building a fire wall for a tank yard, this "Cat" D8 Tractor with No. 80 Scraper, owned by Fred DeBetz, Brighton, Colorado, handles 18 yards of earth per load.



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Filters are the watchmen of an engine's lubricating oil system. That's why "Caterpillar" filter elements are engineered and manufactured to extremely strict standards. They remove harmful particles as small as 39-millionths of an inch . . . remove sludge . . . have large filtering area and high flow rate . . . do not remove beneficial additives . . . are vibration-proof and waterproof. Look under the hide for quality—you'll find it in every "Caterpillar" detail.

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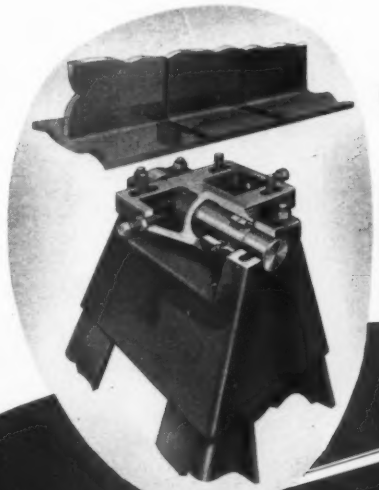
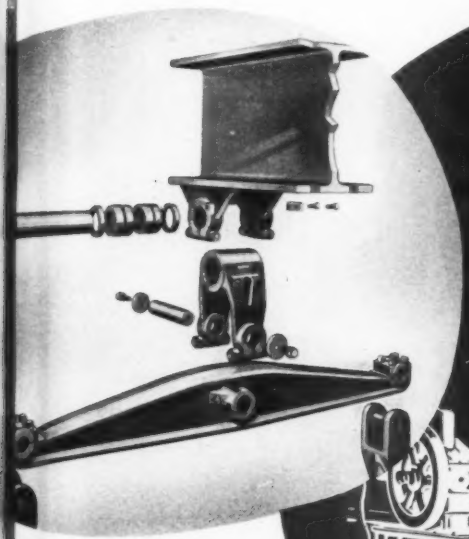
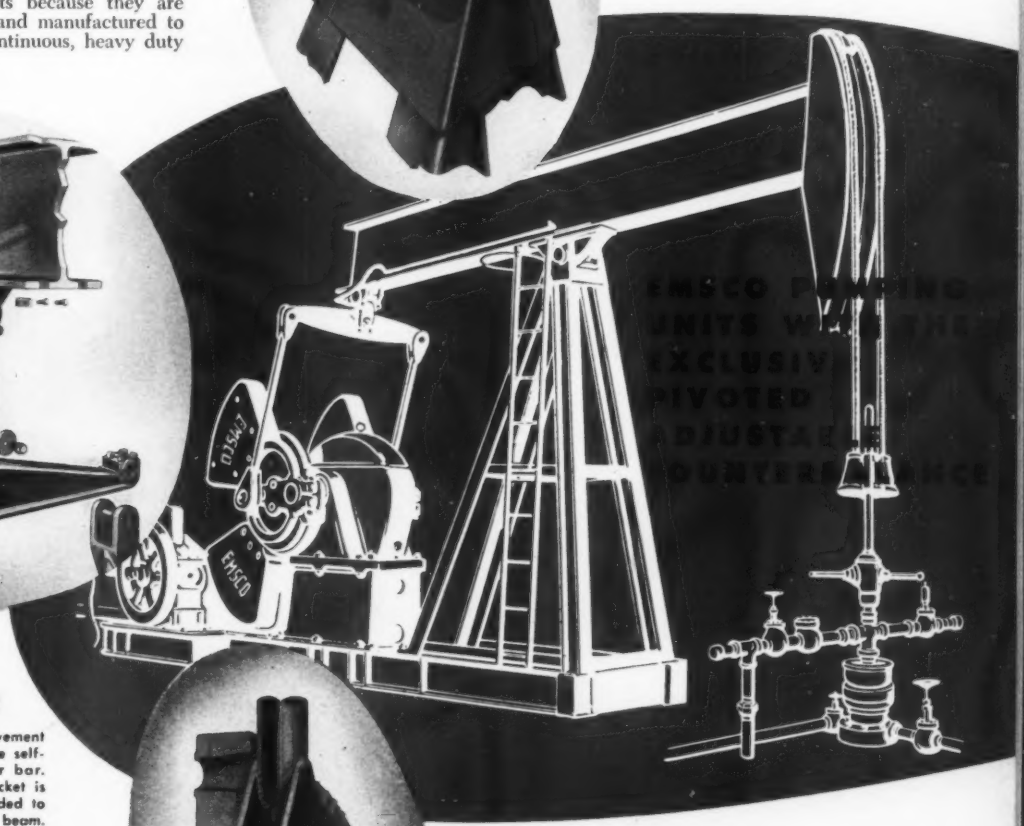
Yes . . . you get more years of service from Emsco Pumping Units because they are *precision* engineered and manufactured to meet the needs of continuous, heavy duty pumping.



CENTER IRON

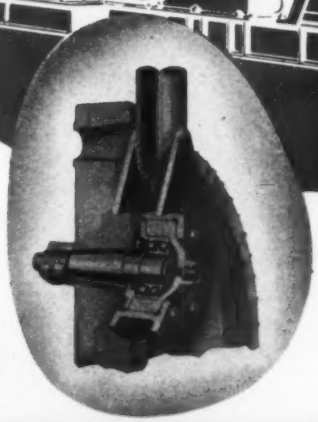
Heavy duty, needle roller bearings mounted in the center iron run on a hardened and precision ground shaft clamped to the top of the Sampson post. Bearings are protected by pressure relieved grease seals. Slotted holes and jack screws in center iron allow positioning of the carrier bar directly over the well head.





EQUALIZER AND EQUALIZER BEARING

This assembly allows free movement in two planes, giving absolute self-alignment of the equalizer bar. Equalizer hanger bearing bracket is a machined steel casting welded to the bottom of the walking beam. Bearing pin is made of hardened and ground alloy steel. Seal protected needle roller bearings are lubricated from top of the safety ladder.



WRIST PIN ASSEMBLY

Self-aligning roller bearings are used in the wrist pin assembly. These self-contained, sealed bearings are safely and easily lubricated by grease fittings conveniently located at the outer end of the wrist pin assembly. Note tapered wrist pin and special lock nuts that positively hold pin in position, yet insure easy removal.

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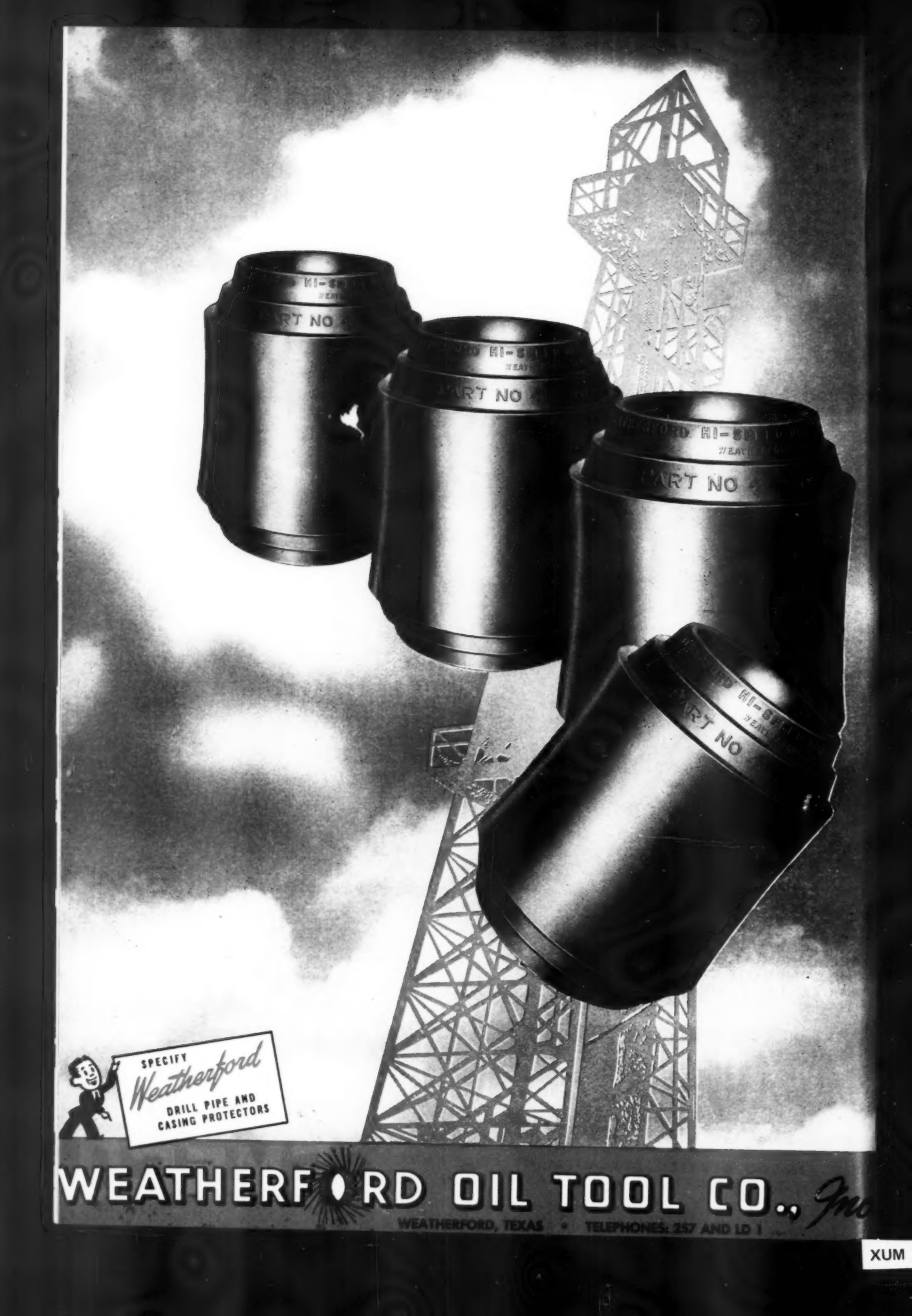
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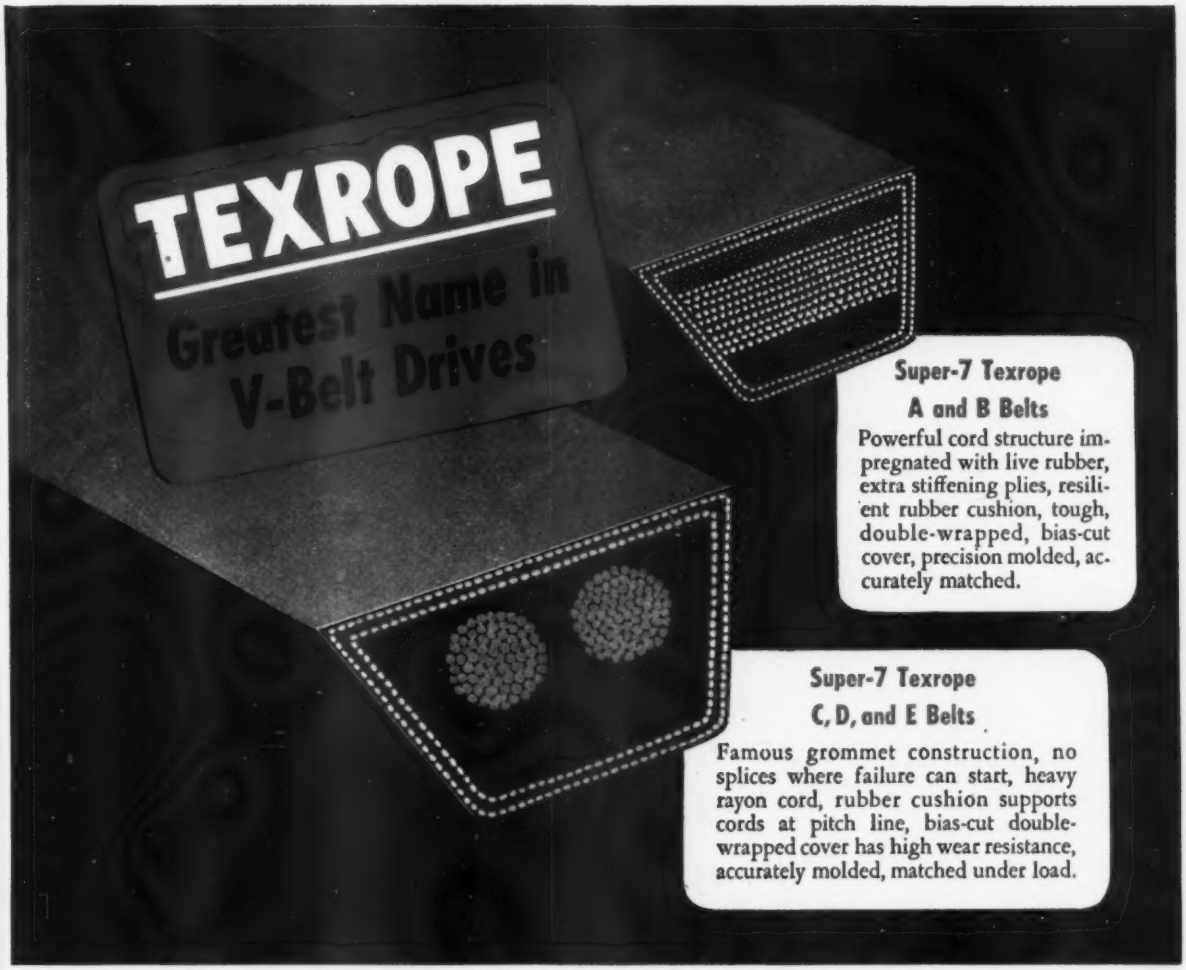
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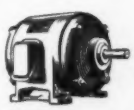

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OIC Valves are at work in many strategic points throughout this refinery. They give efficient, precise control because they're—

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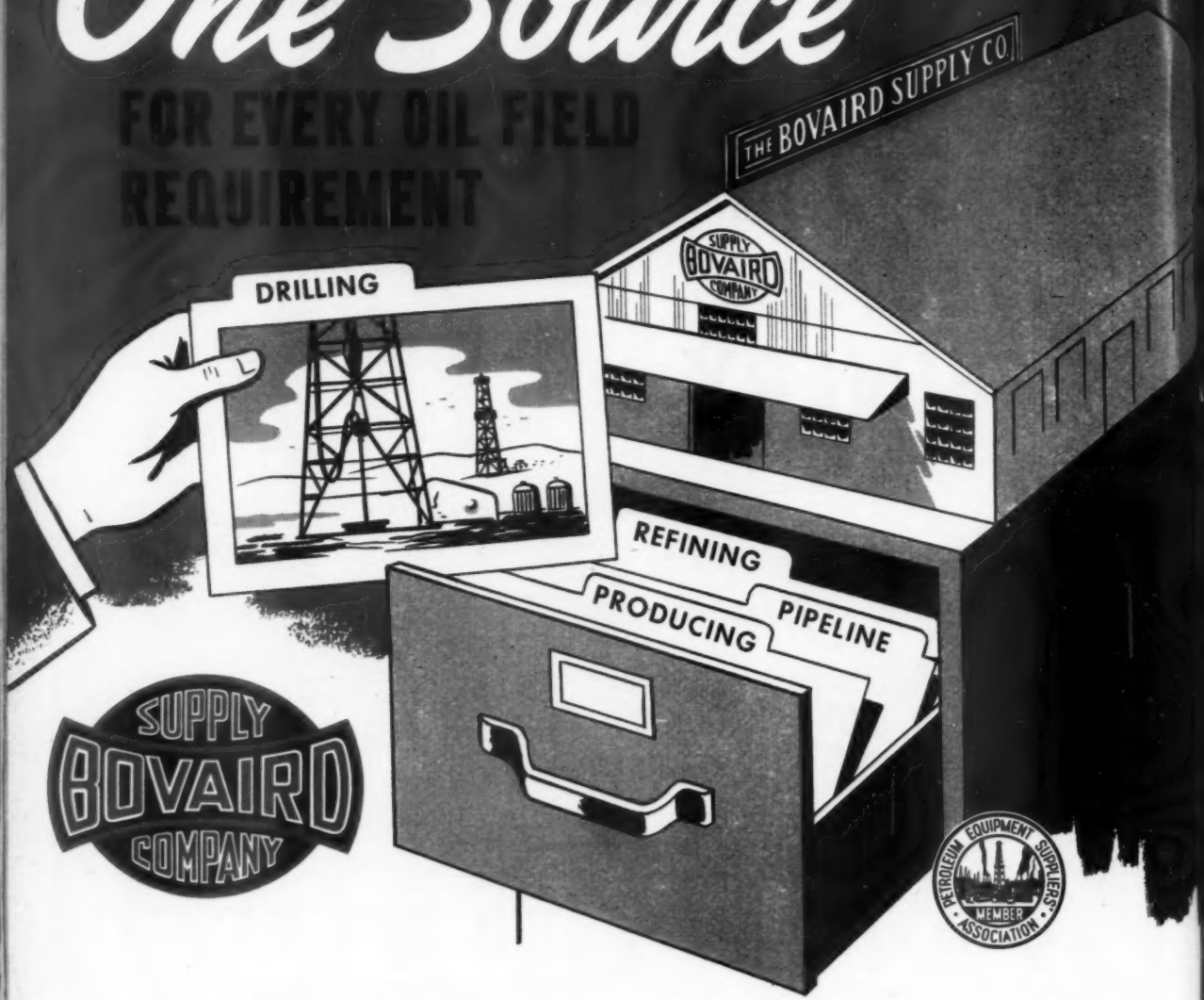

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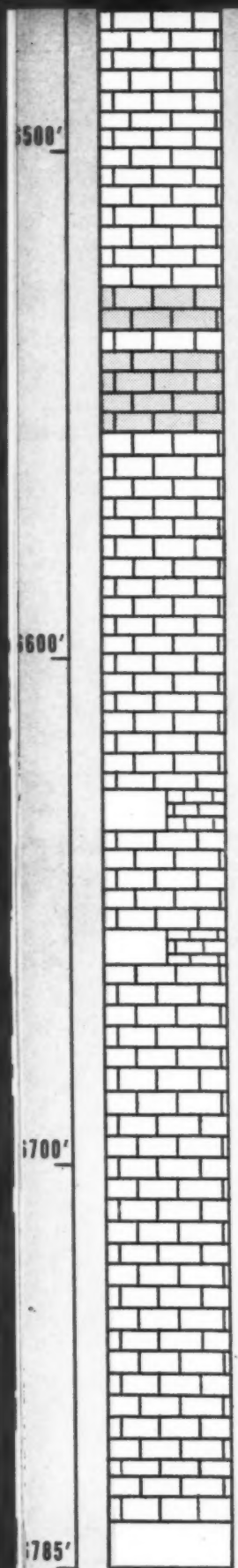

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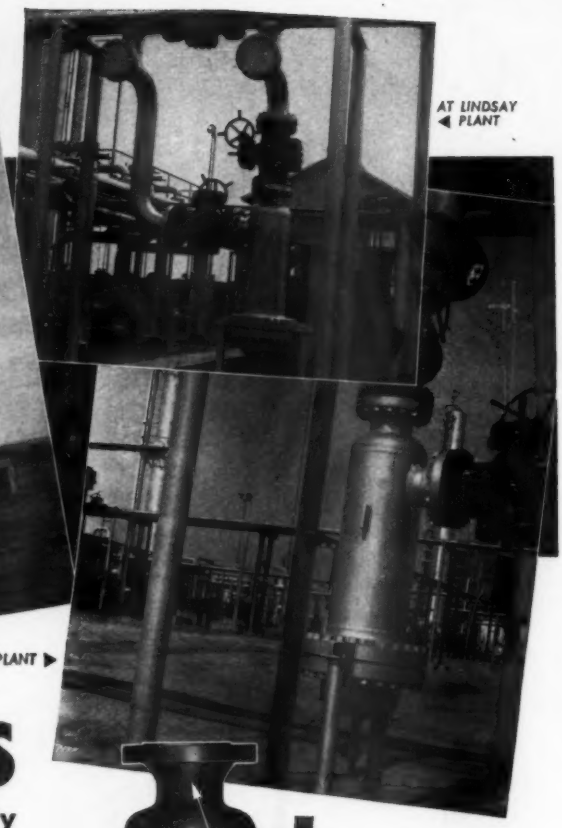

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Staynew FILTERS

in the New Garvin County Plants Protect Compressors, Prevent Injection Well Plugging!

Here, in one of the newest and largest operations of its kind in the entire world, Staynew Filters provide all-important protection for equipment and processing.

In each plant, a Staynew Model HPH Filter removes aluminum oxide generated in the dehydration process from approximately 40 million cu. ft. of gas per day. This aluminum oxide, in the form of an abrasive powder, would cause serious damage if allowed to pass steadily into the lines and equipment which subsequently handle the gas.

In the Antioch Plant, where dehydrated gas is re-pressured to 2400 lbs. and injected into the reservoir, the Staynew Filter not only positively protects the 3 extra re-pressuring compressors against excessive wear, but prevents the pores of the oil-bearing sand from becoming plugged with aluminum oxide.

All Plants Operate Night and Day the Year Around

Such continuous operation would ordinarily require dual installations. However, due to the exclusive Staynew design, a *single filter* only was required at each plant. A by-pass is provided for use during the time required for cleaning or replacement of inserts. Experience indicates that such servicing is not necessary oftener than twice a year, and that only two hours is required for the operation!

This group of filters represents only one of the thousands of Staynew installations in critical service throughout industry. As a result of the many problems solved during these installations, an unsurpassed fund of information in this specialized field has been acquired. For help in solving *your* filtration problems, contact your Dollinger representative, or write direct, care of Dollinger Testing Laboratory.

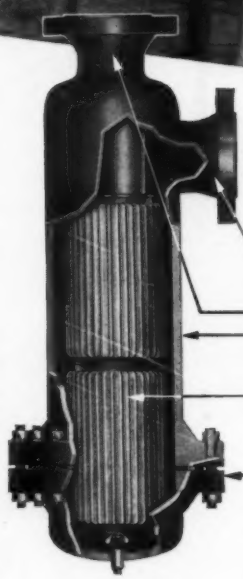

Diagram and Specifications of STAYNEW FILTERS in Service at Garvin County Plants

- Inlet.
- Outlet.
- Forged steel shell, ⅞ in. thickness, certified for 800 lbs. pressure.
- Radial Fin Filter Inserts. Removable by simply unscrewing wingbolt after unbolting head.
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Wt. 3425 lbs.

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New... designed *and specially for* oil drilling contractors and shops

A Genuine MAGNAFLUX INSPECTION UNIT for DRILLING EQUIPMENT

$485 COMPLETE, with instructions and equipment for dry powder inspection.

MAGNAGLO Accessory kit available (at extra cost) for most sensitive and rapid inspection.

LOCATES NOT ONLY SURFACE BUT SUBSURFACE DEFECTS

. . . no other unit under $1400 approaches its sensitivity and convenience.

WHEN the undisputed leader in magnetic particle inspection offers drilling contractors a *performance-proved* portable inspection unit at $485 — it's news.

When that price includes a full day's instruction by a Magnaflux Field Engineer, the right to use the unit under applicable Magnaflux patents, plus full equipment for dry powder inspection — then it becomes news for you to act upon, and quickly!

The new Magnaflux KH-05 is the kind of inspection unit drilling contractors have asked for — to *depend* upon to stop the exorbitant waste of fishing and on-the-job tool failures. It enables any contractor to detect cracks and flaws in drill collars, kellys and other drilling machinery before they become the source of needless, major expense. In time, money and equipment saved, the KH-05 can repay its small cost over and over in the first year you own it!

It is a genuine Magnaflux, with all that means in perfected dependability and performance . . . the result of 20 years spent by Magnaflux developing magnetic particle inspection.

You owe it to yourself to have the full facts. We'll rush a bulletin to you, if you'll *write today*.

Accessories included for $485.00: 3 magnetizing cables with Eitherend connectors, Magnaflux dry powder and bulb.

Set of prods (not illustrated) available as an optional extra. Also, a full Magnaglo kit can be used with the KH-05.

Accessories for any KH-05 use are conveniently stored and rolled to the job—in generous accessory compartment in the unit.

Only with this Unit a combination of features like these:

- **Easily Portable**
- **Both AC and DC magnetizing current from 110 volt AC line.**
- **Magnetizes any *shape*, assembled or disassembled, with wrap around cables 30′ long—and with optional accessory prod kit for current *through* the part.**
- **Permits use of Magnaglo — Proven the most sensitive and rapid inspection medium. Best for cracks in threads or sharp corners.**
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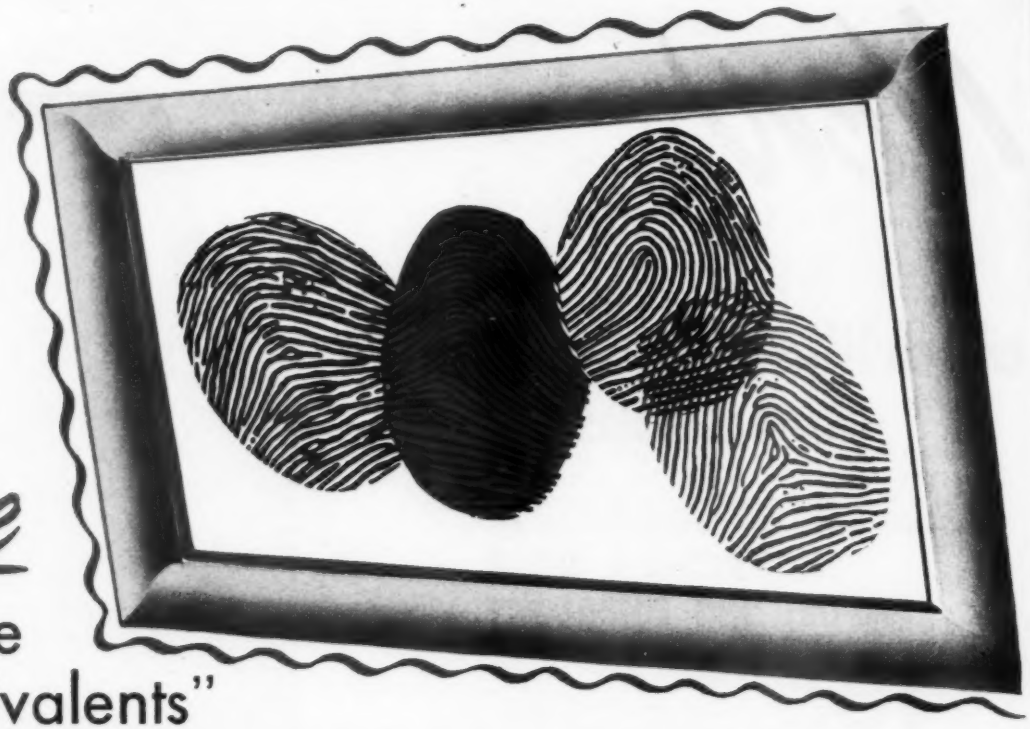
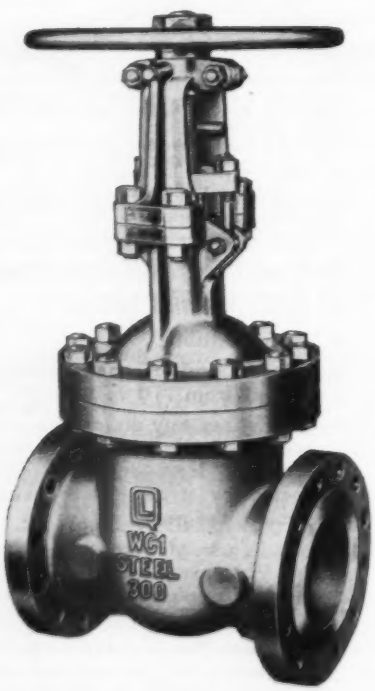


are there "equivalents" to **LUNKENHEIMER** STEEL VALVES?



Well, there are "alternates." But the engineer's familiar specification, "Lunkenheimer Figure 1938 or equivalent," invites a comparison with your thumbprint — and your neighbor's. How "equal" can valves really be? A few characteristics can *almost* be matched. But there is no equal for most Lunkenheimer features. Consider the metal quality of Lunkenheimer steel castings. Their soundness is unparalleled in the valve field. Lunkenheimer metallurgical research has uncovered whole new areas of study, developed exclusive alloys, pioneered in methods of quality control. The amazing records of safety and long service life achieved by Lunkenheimer steel valves are evidence that there *is* no real equivalent for Lunkenheimer metal quality. In workmanship, too, the famous Lunkenheimer tradition of care and precision has never been equalled. New machines (most of Lunkenheimer's machinery is less than three years old) are making possible *even higher* standards of workmanship. The *only* equivalent to a Lunkenheimer steel valve is another of the same design —a Lunkenheimer. For the address of your nearest representative, and for more steel valve data, write to The Lunkenheimer Co., P. O. Box 360F, Cincinnati 14, Ohio.

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LUNKENHEIMER

THE ONE *Great* NAME IN VALVES

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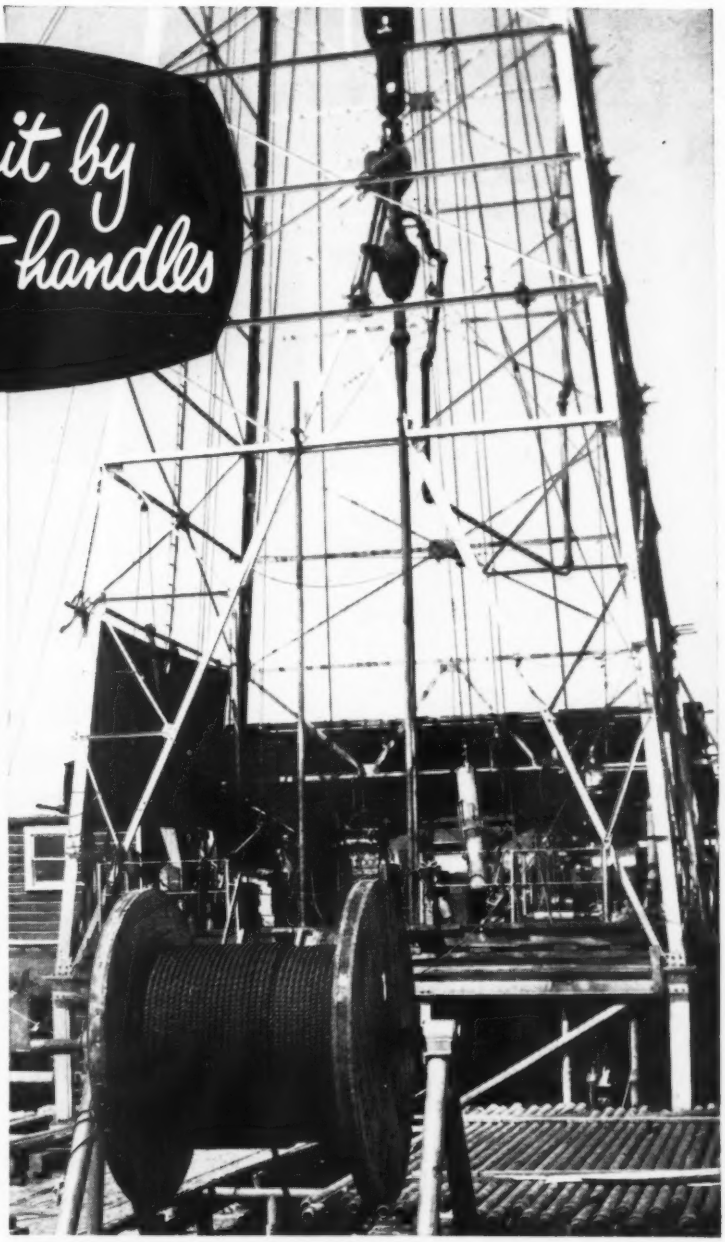
SOME of the world's deepest wells have been drilled with TIGER BRAND Wire Lines . . . and some of the fastest drilling records have been set with rigs strung with TIGER BRAND. These outstanding jobs prove the outstanding performance of TIGER BRAND Rotary Lines.

But there's one record that may be of more interest to you than any of these—and that's the day-by-day record of "low cost per ton mile" on your own rig. We have seen enough performance records to know that TIGER BRAND Lines, when properly handled, will give you the most service for dollar of cost.

There's a reason for this. Through constant research on the strength of various steels, wearing qualities, flexibility, construction and lubrication, our engineers have determined the best combination of properties for any particular job. When you use TIGER BRAND Wire Lines, you automatically get the benefit of this research and experience.



TIGER BRAND 1¼" ROTARY DRILLING LINE on a well near Cordell, Oklahoma. This contractor keeps an accurate record of wire rope life and uses a high percentage of Tiger Brand.

AMERICAN STEEL & WIRE COMPANY, GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA STEEL COMPANY, SAN FRANCISCO
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

AMERICAN TIGER BRAND WIRE LINES

USS *Excellay Preformed*

USS AMERICAN TIGER BRAND WIRE ROPE UNITED STATES STEEL

SEND FOR FREE BOOKLET

American Steel & Wire Company
Rockefeller Building, Dept. P-10
Cleveland 13, Ohio

Gentlemen:

Please send me a copy of your booklet, "U·S·S American TIGER BRAND Wire Lines For Oil, Gas and Water Wells."

Name.....

Company.....

Position.....

Address.....

UNITED STATES STEEL

XUM

COST WHEN MADE FROM FORGINGS—$1.714

Cost of forging per unit . . **$0.4228**

Production cost per unit (broached and then machined on chucking automatic) **$1.2912**

TOTAL COST PER UNIT—$1.714

COST WHEN MADE FROM TIMKEN TUBING—$1.47

Cost of tubing per unit . . **$0.293**

Production cost per unit (with mill-length tubing on 4-spindle 5" capacity automatic screw machine) **$1.177**

TOTAL COST PER UNIT—$1.47

Why this sleeve now costs 24.4¢ less

WHETHER you're making your hollow cylindrical parts from forgings or bar stock, chances are you can save money by switching to Timken® seamless tubing. For example, by using Timken tubing in place of forgings for the sleeve part shown here, the manufacturer cut his costs from $1.714 to $1.47 per piece.

This saving was possible for two reasons: 1. Unit for unit, Timken seamless tubing was far less expensive than forgings. 2. The mill lengths of tubing could be broached and machined on an automatic screw machine, whereas the forgings had to be broached and then maintained on a chucking automatic. The saving was so great that the cost of the new screw machine and tooling —$33,000—was more than paid for during the first year. The tables above give you the actual cost breakdowns.

Timken seamless tubing offers cost advantages over bar stock as well as forgings. The hole is already there. You can often start right in with finish boring. Scrap loss is reduced—machining time saved.

And you get better quality too. The piercing process by which Timken tubing is made is basically a forging operation, resulting in greater product strength. From tube to tube and heat to heat, this fine forged quality is always uniform, thanks to Timken's rigid controls.

OUR TUBE ENGINEERING SERVICE will choose the most economical size tube for you . . . guaranteed to clean up to your finish dimensions. Write The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

Specialists in alloy steel—including hot rolled and cold finished alloy steel bars—a complete range of stainless, graphitic and standard tool analyses—and alloy and stainless seamless steel tubing.

BARRETT* PROTECTIVE PRODUCTS
COVER EVERY PIPE-COATING NEED

1 **Pipeline Enamel**
2 **Millwrap Enamel**
3 **A.A. Enamel**
4 **Asbestos Felt**
5 **Materials for Special Uses**

BARRETT* MATERIALS FOR SPECIAL USES

BARRETT* CA-50 HEAVY-DUTY COLD APPLICATION COATING. Protects metal or concrete exposed to severely corrosive acid or alkali vapors in industrial plants . . . dam and flood control works . . . sewage disposal plants . . . wherever extra-heavy, durable protection is required.

BARRETT* ETERNIUM* PAINT. This high-quality coal-tar paint has been used successfully for many years to protect metal and woodwork in mines, chemical plants, or wherever corrosive conditions are severe.

BARRETT* 34 YB COLD APPLICATION COATING. Withstands corrosive conditions of waterfront and marine conditions, such as piers, ships, floating drydocks, and service vessels for off-shore oil and gas wells.

BARRETT* SERVICE CEMENT. The standard for many years for protecting field joints of welded pipe. This coal-tar "putty" is applied cold. No priming or torching of surface is required. Used with Barrett Pipeline Fabric.

BARRETT* PIPELINE FABRIC. This strong, durable, coal-tar saturated fabric is widely used as a reinforcing membrane or tape. Barrett Service Cement is used with it to protect field joints of pre-coated pipes.

BARRETT* INDUSTRIAL COATING. Provides corrosion control under the most punishing conditions of Industrial Plant corrosive exposures. For maximum resistance, this heavy-bodied liquid coal-tar paint is reinforced with inert minerals. Extreme cold does not affect it, and it also withstands dry heat of approximately 400° F.

✓ *Memo:* **FOR CORROSION ENGINEERS**

Attention to product quality, and knowledge of the service requirements of every product, explains why Barrett coal-tar coatings for special uses are so satisfactory and dependable.

The listing above covers only six of the many *Barrett Materials for Special Use.* The Barrett organization will be most happy to consult with you—without cost or obligation—on any special protective problems you may have. A satisfactory solution will almost certainly be found among Barrett's many, and moderately priced, specialized protective coatings.

Barrett*

THE BARRETT DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street, New York 6, N. Y.

*Reg. U. S. Pat. Off.

Cummins® Custom-built Diesels

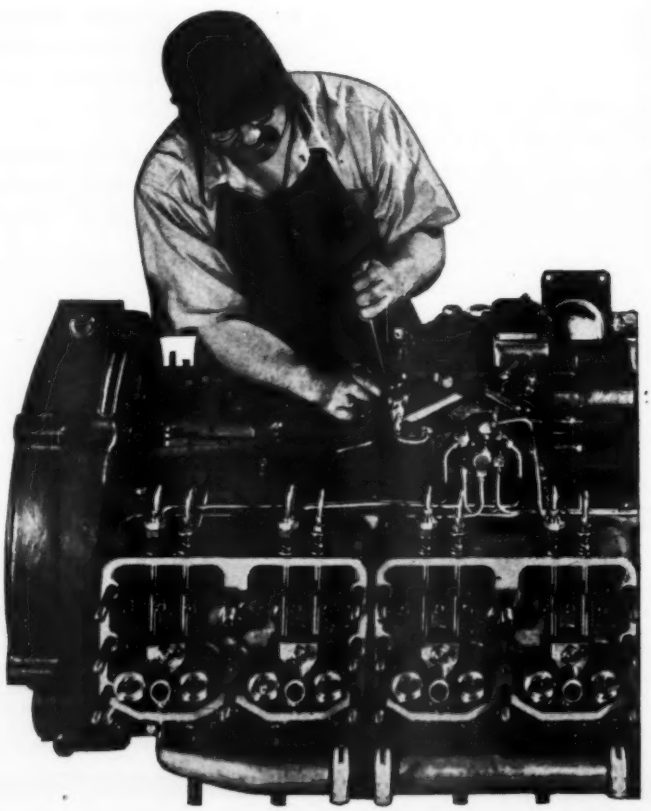
Built not once but Twice

The better-built engine for better power profits

Every lightweight high-speed Cummins Diesel is actually built *twice*. After initial assembly, each engine is run-in on the test block. Then it is torn down and carefully re-inspected — after that it is re-assembled and tested *again* to assure *peak performance*. And that is only *one* example of the extra care, the precision-workmanship . . . that goes into every Cummins custom-made engine.

That's why a Cummins Diesel is an investment that has *greater earning power* for you. The finest of engine-craftsmanship...exclusive Cummins fuel system...and custom-built engines "that fit your job" make a rugged, quality-engineered Cummins Diesel *the better buy for your power needs.*

Contact your Cummins dealer. He has more facts to show you about making more profits with



CUMMINS Dependable DIESEL

Diesel power by CUMMINS

TRADEMARK REG. U. S. PAT. OFF.

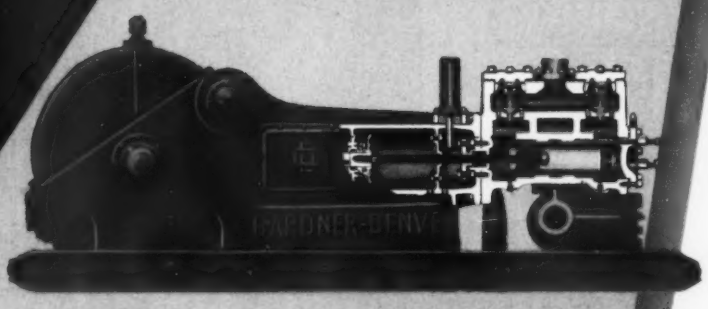
CUMMINS ENGINE COMPANY, INC. • COLUMBUS, IND.

EXPORT: CUMMINS DIESEL EXPORT CORPORATION
Columbus, Indiana, U. S. A. • Cable: Cumdiex

Lightweight High-speed Diesel Engines (50-350 hp) for: On-highway trucks • off-highway trucks • buses • tractors • earth-movers • shovels • cranes • industrial locomotives • air compressors logging yarders and loaders • drilling rigs • centrifugal pumps generator sets and power units • work boats and pleasure craft.

FOR TOP PERFORMANCE

Use Only GARDNER-DENVER Slush-Proof Parts !



RDNER-DENVER "SLUSH-PROOF" LINERS

ade of special alloy steel, car-rized, hardened, ground and spected by Magnaflux. Liners e held in the cylinders by steel mp rings and alloy steel screws. e liner packing assembly con-sists of two rubber rings separated by a steel spacer ring. The steel spacer ring and the tell-tale hole in the cylinder provide a means of checking liner packing for tightness.

GARDNER-DENVER VALVES AND SEATS

The Duoseat Valves are guided top and bottom. Steel-to-steel contact of valve and seat at center and at the outside carries the loads imposed by closing impact and fluid pressure, while the rubber-to-steel seat provides a flexible seal. Valve bumpers and seats are alloy steel forgings, carburized, hardened, and heat-treated. Rubber inserts and upper guides are replaceable.

ARDNER-DENVER "SLUSH-PROOF" FLUID PISTON RODS

ade from alloy steel, carburized, hardened, ground and inspected y Magnaflux. Piston ends of the rods are tapered for API pistons.

Parts made for a pump by the pump manufacturer give the best service. A plain, simple truth... but sometimes overlooked when replacements are needed.

It has been proved by field operation that the use of genuine Gardner-Denver Slush-Proof Parts in Gardner-Denver Mud Pumps results in less down time. Because Gardner-Denver parts are made to the exact specifications of the pump and no other part can be substituted with maximum performance as a result.

Of course the need for replacement of parts is less frequent, too, when you have a Gardner-Denver Slush Pump on the job. For a Gardner-Denver Pump is originally built with all the strength, sturdiness and rigidity possible. It stands the beating while it gives *better* performance.

CONTINENTAL

SERVING THE OIL AND GAS INDUSTRIES

THE CONTINENTAL SUPPLY COMPANY, *General Offices:* DALLAS, TEXAS

The Continental Supply Company, Limited, 216 Lancaster Building, Calgary, Alberta

***Export Division:* The Continental Supply Co., Inc., 30 Rockefeller Plaza, New York, N. Y.**

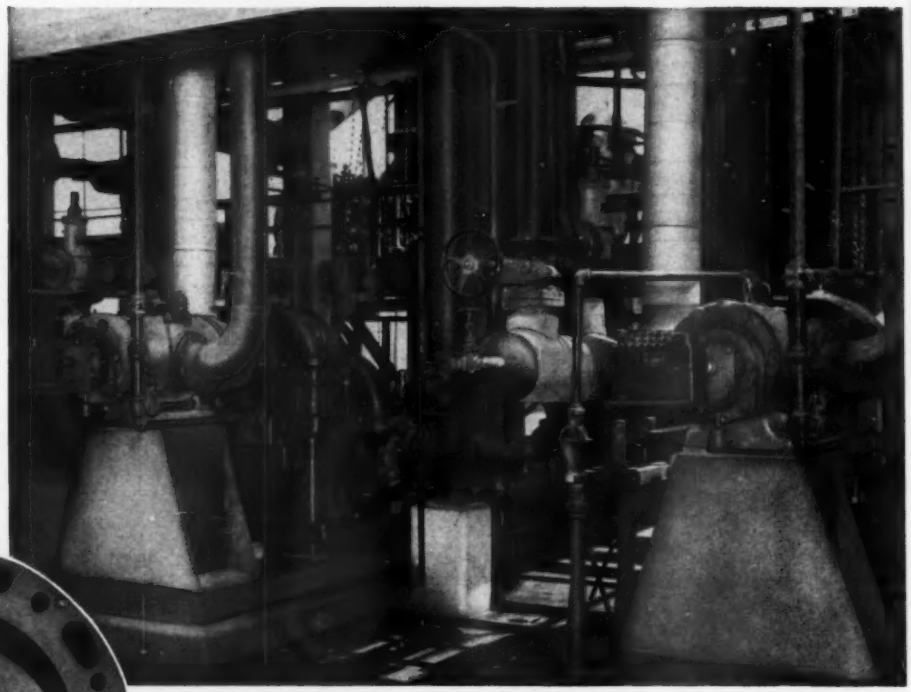
Representatives: ARGENTINA • BOLIVIA • BRAZIL • CHILE • COLOMBIA • ENGLAND • ECUADOR • PERU • TRINIDAD • URUGUAY • VENEZUELA

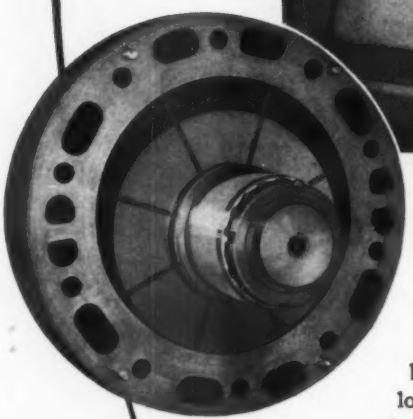
XUM

fuller

DRY MATERIAL CONVEYING SYSTEMS AND COOLERS
COMPRESSORS AND VACUUM PUMPS
FEEDERS, AND ASSOCIATED EQUIPMENT

sound
lungs
for
industry





FULLER rotary compressors

Fuller Rotary Compressors are first choice for dependability in refineries of every size the country over. That's only natural, because Fuller engineers and builds for trouble-free, long-term, low-cost operation. Fuller Rotary Compressors have but few moving parts . . . rotor, bearings, and blades. They need little attention, infrequent inspection. Maintenance is low since there are no valves to leak or seats to grind, and blades automatically compensate for wear. *Full capacity is maintained for the life of the machine.*

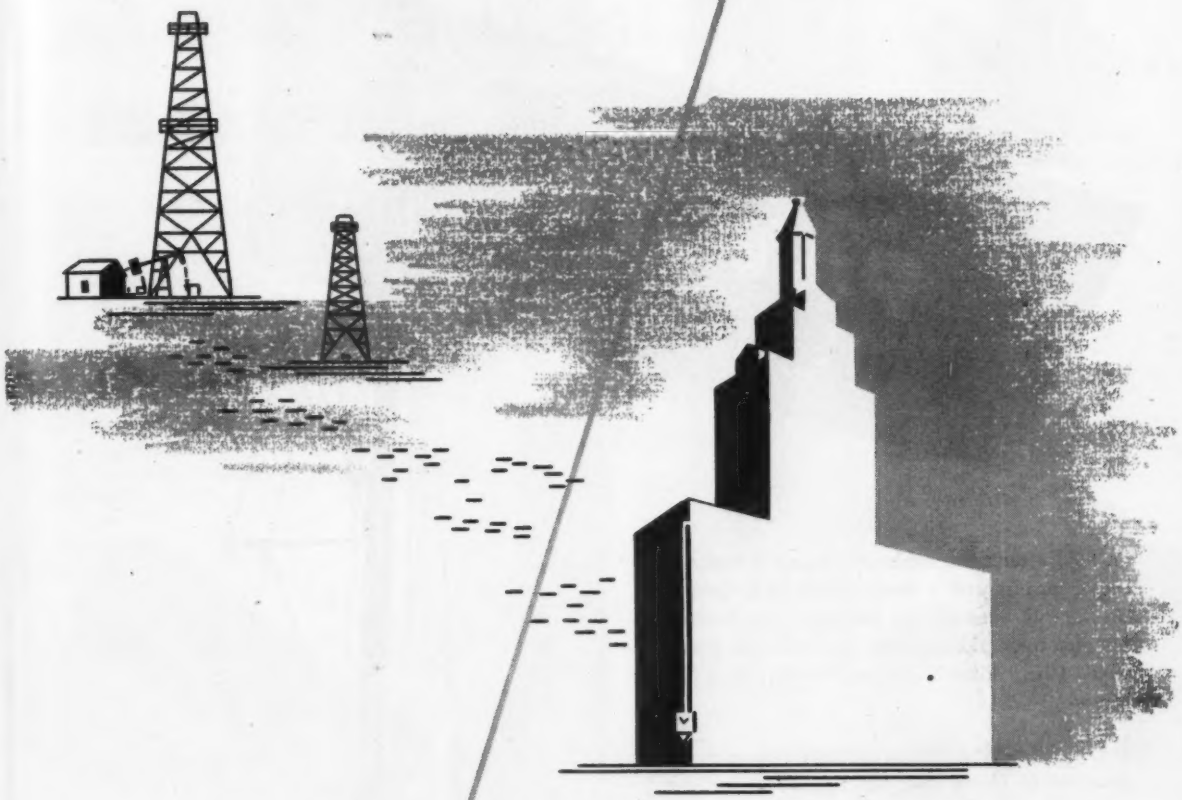
It's this lifetime of new machine efficiency that makes them the logical, economical choice for general plant air, purging gas, for refrigeration in alkalization units, and for handling natural, manufactured, and various refinery gases. And they can't be beat as prime factors in reducing installation as well as operating costs.

A Fuller engineer will be glad to show you how Fuller Rotary Compressors can go on your payroll at the minimum wage. Get in touch with him today . . . or write for Bulletin C-5 which describes Fuller Rotary Compressors in detail.

C-200

FULLER COMPANY, Catasauqua, Pa. · 120 So. LaSalle St., Chicago 3 · 420 Chancery Bldg., San Francisco 4

IT COSTS BIG MONEY TO DRILL!



and it's available . . . at NBT

Oil operators have long turned to National Bank of Tulsa for finances to bring to the surface their proven reserves. Friendly loan officers have always approached these needs with comprehensive understanding and practical experience. If this appeals to you, come and see us. Your sound plans will receive a fair decision and quick action.

The Oil Bank of America

NATIONAL BANK OF TULSA

OFFERING COMPLETE BANKING AND TRUST SERVICES

Member Federal Deposit Insurance Corporation

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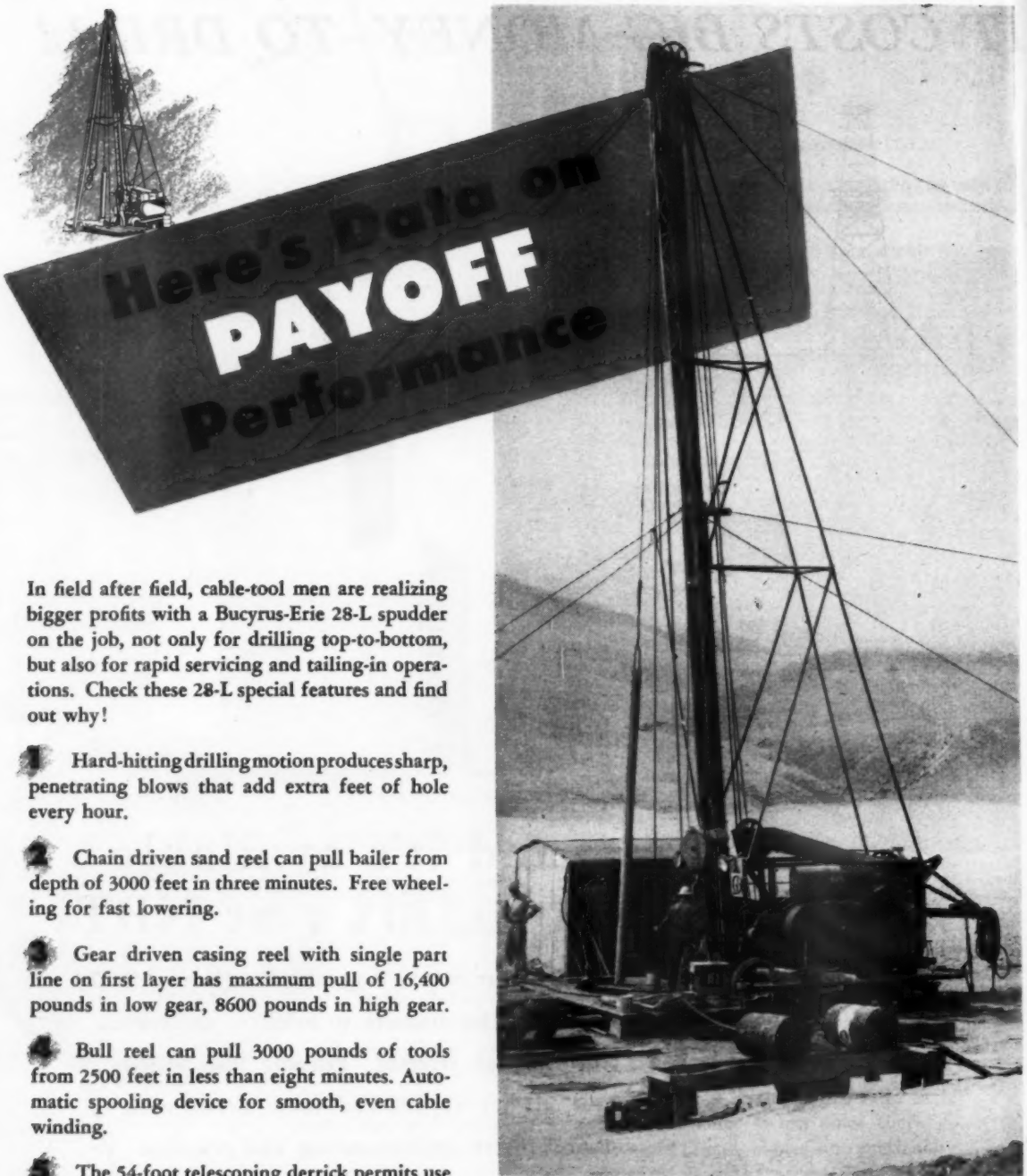


In field after field, cable-tool men are realizing bigger profits with a Bucyrus-Erie 28-L spudder on the job, not only for drilling top-to-bottom, but also for rapid servicing and tailing-in operations. Check these 28-L special features and find out why!

1. Hard-hitting drilling motion produces sharp, penetrating blows that add extra feet of hole every hour.

2. Chain driven sand reel can pull bailer from depth of 3000 feet in three minutes. Free wheeling for fast lowering.

3. Gear driven casing reel with single part line on first layer has maximum pull of 16,400 pounds in low gear, 8600 pounds in high gear.

4. Bull reel can pull 3000 pounds of tools from 2500 feet in less than eight minutes. Automatic spooling device for smooth, even cable winding.

5. The 54-foot telescoping derrick permits use of large bailers and long tool strings; handles static casing loads up to 75,000 pounds with strut and auxiliary leg.

6. Two speeds forward and one reverse on all reels provide the split-second control required by diversified operations.

In handling drilling to 2500 feet or servicing to 3000 feet, you'll find the 28-L can mean added profits. Investigate the 28-L and its companion models — 24-L, 36-L, 48-L. You'll find there's a modern mobile Bucyrus-Erie spudder for every job range. See your nearest Bucyrus-Erie spudder distributor for complete information.

71550

BUCYRUS ERIE

South Milwaukee, Wisconsin

Distributors in All Principal Oil Fields

Drill Sales Division Offices

Dallas, Tex., Evansville, Ind., Englewood, N. J.

For Quiet Engine and Compressor Operation

Install BURGESS-MANNING SNUBBERS

To reduce engine exhaust and compressor intake noises, Burgess-Manning Snubbers are the answer. Turbulent slugs of hot exhaust gas or incoming pulses of air are snubbed so that the oscillating flow of gas, which causes noise, is smoothed to a unidirectional flow without appreciable restriction. The flow of gas from the engine, or the flow of air into the engine or compressor becomes smooth and quiet.

For a solution of your noise or gas surging problems, consult Burgess-Manning engineers.

SDG Slug Buster Snubber

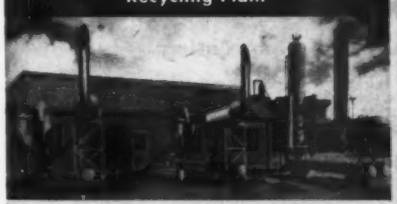
Burgess-Manning Snubbers on Fluid Catalytic Cracker

APPLICATIONS

- Drilling
- Oil well pumping
- Crude oil and product pipe lines
- Gas transmission
- Repressuring
- Recycling
- Refineries
- Gasoline plants

From the Producing Well, through the Refinery Gate . . . It's Burgess-Manning

Recycling Plant



Two Burgess-Manning Exhaust Snubbers outside recycling plant.

Rotary Drilling Engines

Burgess-Manning Snubbers on rotary drilling engines at Shawnee Drilling Co., Shawnee, Oklahoma.

Oil Pumping Station

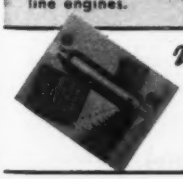
Three Burgess-Manning Snubbers on engines at Shell Oil plant in California.

Pipe Line

Burgess-Manning Exhaust Snubbers on pipe line engines.

Portable Drilling Rig

Portable oil rig using Burgess-Manning Snubber.



Write for Bulletin

Bulletin No. 497 features Burgess-Manning's new SDG Slug Buster Snubber.

BURGESS-MANNING COMPANY

LIBERTYVILLE, ILLINOIS

XUM

Pay Less

with this ONE-STOP

Supply service means to a driller what supply lines mean to an army. From the Rockies to the Atlantic and from the Gulf to Canada, countless drillers proceed with more confidence because of Jones & Laughlin Supply service: 80 Stores, 17 Sales Offices, 8 Resident Salesmen.

On the right is listed some of the well-known, time tested equipment always available through this widespread organization, regardless of the movements of your crews. When you move, the supply line is already there, established and dependable.

Each brand is tops. You drill more economically. You make better time. You minimize accidents. You thoroughly enjoy the prompt, friendly, appreciative service — ONE-STOP service — that comes with equipment from Jones & Laughlin Supply Company.

We cordially invite you to establish contact now with a supply line always at your elbow when you need it.

Wheland
Drilling Rigs, Crown Blocks, Traveling Blocks, Mud Pumps, Swivels and Rotaries.

Jones & Laughlin
Wire Rope, Drill Pipe, Casing.

Republic
Rotary Hose, Vibrator Hose, "V" Belts.

"American Brand"
Cordage.

Wilson
Drilling Rigs.

Byron Jackson
Tongs, Elevators, Hooks, Links.

Baroid
Drilling Mud.

Many other Rotary Drilling Specialties.

for Hole Supply Service

Member Petroleum Equipment Suppliers Association.

80 STORES
17 SALES OFFICES
8 RESIDENT SALESMEN

Jones & Laughlin Supply Company

"... here's MY warehouse!"

Subsidiary of
Jones & Laughlin
Steel Corporation

J&L STEEL

TULSA, OKLAHOMA

EXPORT: 405 LEXINGTON AVE., NEW YORK, N.Y. U.S.A.

Get a better day's work out of your Truck Dollar

CHEVROLET TRUCKS

CHEVROLET

You invest money in a truck to *get work done.* And you can prove to your own satisfaction that a Chevrolet truck does more work for every dollar you put into it.

You get *more for your money* right from the start, because your Chevrolet truck is priced at rock bottom. Chevrolet volume production—far and away the biggest in the truck field—makes possible extra features and extra engineering advantages at lowest cost.

You get *more for your money* every driving mile, because Chevrolet trucks are economical to operate. The top-rated efficiency of Chevrolet Valve-in-Head engine design saves money on gas and oil day in, day out.

You get *more for your money* right through the years, because your Chevrolet truck cuts upkeep to the bone. Hypoid rear axles, diaphragm spring clutch, ball-type steering and many other great truck features help keep your truck on the job and out of the shop.

Get the full "more-work-per-dollar" story from your Chevrolet dealer—and get America's biggest selling, best performing truck: Chevrolet.

CHEVROLET MOTOR DIVISION, *General Motors Corporation*
DETROIT 2, MICHIGAN

These Great Features Help Tell Why CHEVROLET TRUCKS ARE THE FIRST CHOICE OF TRUCK BUYERS EVERYWHERE

TWO GREAT VALVE-IN-HEAD ENGINES: the new Loadmaster and the improved Thriftmaster—to give you greater power per gallon, lower cost per load • THE NEW POWER-JET CARBURETOR: smoother, quicker acceleration response • DIAPHRAGM SPRING CLUTCH for easy-action engagement • SYNCHRO-MESH TRANSMISSIONS for fast, smooth shifting • HYPOID REAR AXLES—5 times more durable than spiral bevel type • DOUBLE-ARTICULATED BRAKES —for complete driver control • WIDE-BASE WHEELS for increased tire mileage • ADVANCE-DESIGN STYLING with the "Cab that Breathes" • BALL-TYPE STEERING for easier handling • UNIT-DESIGN BODIES—precision built.

Sure cure for many a headache...

DARLING CAST STEEL PIPE LINE GATE VALVES

IF you're a believer in "proof of the pudding", you have only to check with Darling users to get facts on how Darling pipe line valves can save you time and money and prevent chronic valve headaches. For one thing, there's Darling's unique *fully revolving, double disc, parallel seat feature* . . . revealed in the cutaway view. It's simplicity itself, but it wins hands down by cinching:

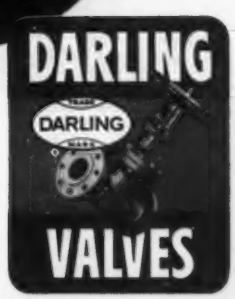
1. Positive, easy, tight closing. **2.** Automatic adjustment for valve body distortion. **3.** Elimination of gate-to-seat galling. **4.** Uniform wear distribution. **5.** Greater service life with less maintenance.

SEND FOR DATA — Space here won't permit a complete explanation of just *why* this feature gives you these and many other important advantages. That's why we suggest that you send for *all* the facts. Darling parallel seat gate valves come in a wide range of sizes and constructions for main line, gathering, manifold, tank farm and all other pipe line services. Outline your particular service needs or ask for complete descriptive bulletin.

Darling 22" Series 400 motor-operated cast steel, fully revolving, double disc, parallel seat pipe line gate valve for cold pressures up to 800 lbs. Darling pipe line gate valves have full seat opening, same as I.D. of pipe, allowing free passage of line scrapers.

DARLING VALVE & MFG. CO.
WILLIAMSPORT 1, PA.

FOR PLUS VALUES, JOB PROVED AGAIN AND AGAIN



AT LAST REPORT, this string of "K" Monel sucker rods had been used continuously for 8 years in the Howard Glasscock Field at Big Spring, Texas. Before switching to "K" Monel, there was a rod break every 50 days, the entire string needed replacement every 5 months.

Corrosive wells can be operated profitably with equipment made of Monel® and "K"® Monel.

This has been proved time and again—even in the sour gas areas of West Texas and New Mexico.

It is easy to see why. Monel, for example, is strong and tough. It is highly resistant to corrosion by brine and sour crude. It withstands the cutting action of high pressure gas, and the abrasive effects of entrained solids.

"K" Monel has the same characteristics, coupled with the added advantages of even greater strength and hardness. It is non-magnetic. By heat treatment, its tensile strength can be developed to 140-170,000 psi, and its hardness to 265-320 Brinell.

These important facts about Monel and "K" Monel are helpful guides in . . .

Choosing the
RIGHT EQUIPMENT *for* CORROSIVE WELLS

THESE TWO BELLOWS were used in a gas lift valve in the same sour well. Photo at left shows condition of the best previous bellows after 19 days. Compare this with other photo, taken of a Monel bellows when it was removed for inspection after 141 days of use.

Both alloys are used for parts subject to alternating stresses in the presence of corrosives. Their retention of good fatigue strength is particularly evident in lengthened equipment life. Under varied conditions of temperature, pressure and velocity, Monel and "K" Monel stand up where other materials frequently *give* up.

Our illustrated booklet, ***Controlling Corrosion in Petroleum Production Equipment,*** tells how you can put Monel, "K" Monel and other INCO Nickel Alloys to work for you. It brings you the details of typical performance and service records like the three shown on this page. It contains individual sections dealing with exploration and drilling, pumping, and gas control.

The booklet tells, too, how you can get free technical advice on the selection of materials for severe service, and contains a listing of valuable bulletins and other literature that have been prepared for your use. Write us—*now*—for your copy. No obligation.

BALL AND SEAT VALVE of "K" Monel. At depth of 3,500 feet, pulsating 28,000 times a day, and subjected to the action of corrosive crude, one of these heat treated "K" Monel valves lasted 10 months, 22 days. Alloy steel valve in same well lasted only 21 days.

• • •

USE MONEL OR "K" MONEL TO CUT REPLACEMENTS OF . . .

Ball and Seat Valves . . . Chokes . . . Drill Collars . . . Gas Lifts . . . Gauges . . . Instrument Parts . . . Polished Rods . . . Pump Shafts . . . Springs . . . Subs . . . Sucker Rods . . . Valve Stems . . . Wire Lines . . . Working Barrels . . . and many other items of oil field equipment.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

EMBLEM OF SERVICE
INCO
TRADE MARK

MONEL . . . "K" MONEL . . . YOUR PARTNERS IN PROGRESS

Make FORD power YOUR power

Ford

INDUSTRIAL ENGINES

YOUR JOB IS WELL-POWERED WHEN IT'S FORD-POWERED

Ford "254" POWER UNIT

Six Cylinder, 254 cu. in. displacement, Gross Dynamometer Brake Horsepower 94 @ 2400 RPM.

(Also available in open type power unit or engine assembly only)

...and be RIGHT 3 WAYS!

1. **RIGHT POWER** . . . you have five Ford power sizes to choose from . . . all engines and units are factory-tested . . . ready to install . . . complete and ready to run.
2. **RIGHT FEATURES** . . . every model reflects all the benefits of Ford's famed progressive engineering.
3. **RIGHT SERVICE** . . . as near as your nearest Ford Dealer, clear around the world.

FORD INDUSTRIAL ENGINES

are offered as complete power units or as individual units, either open or closed, both with a wide variety of special attachments. They are made in the following types and sizes:

120 CU. IN. 4 CYLINDER
226 CU. IN. 6 CYLINDER
254 CU. IN. 6 CYLINDER
239 CU. IN. V-TYPE 8 CYLINDER
337 CU. IN. V-TYPE 8 CYLINDER

Leading machinery and equipment builders—makers of agricultural machinery, road and construction equipment, lumber and sawmill machinery, oil field equipment and various other applications—are swinging to Ford Industrial Engines and Power Units more and more for their power sources.

They choose Ford first because they know Ford standards of engineering, design and production are notably high.

FORD POWER FOR STEADY PERFORMANCE. You can *depend* on Ford Industrial Engines and Power Units. Each engine and unit is thoroughly inspected and test run at the factory, before shipment. Ford Power Units are delivered to you complete and ready for use.

FORD POWER FOR SERVICE EVERYWHERE. Your equipment customers want prompt, economical service when they need it. Owners of equipment and machinery powered by Ford save time and money on service and parts replacement because Ford Service is available everywhere, helps cut "down-time."

FORD POWER FOR SMART APPEARANCE. Up-to-date products need up-to-date power that looks smart. Ford Industrial Engines and Power Units are smart looking, well designed and compact. Their appearance is Ford-engineered to harmonize with the best in modern machinery and equipment design.

Industrial Engine Department

FORD MOTOR COMPANY

Dearborn, Michigan

For Special Literature on Ford Industrial Engines and Power Units, Use This Coupon . . .

INDUSTRIAL ENGINE DEPT., FORD MOTOR COMPANY, DEARBORN, MICHIGAN

Please send me comprehensive literature about Ford Industrial Engines and Ford Power Units.

Name_____
(Please print)

Address_____

City_____ State_____

XUM

—of a Kidde Dry Chemical Fire Extinguisher

Pound for pound, *Kidde* Dry Chemical Fire Extinguishers give you more *protection* for fires in flammable liquids, live electrical equipment and for textiles.

Proof? Factory Mutual Laboratories requires a 20 lb. dry chemical fire extinguisher, in the hands of an experienced operator, to effectively cover 25 square feet of burning area. *The Kidde 20 pounder covered 36 square feet . . . a 44% margin of safety!* And—the tests require a 30 pounder to cover 35 square feet . . . *but Kidde's Dry Chemical extinguisher reached out 48 square feet!*

Why is Kidde better? A special Diffuser Horn applies heat-absorbing, fire-smothering dry chemical in an effective cloudlike pattern that blankets the danger area, helps eliminate splashing of burning liquids, and protects the operator from heat.

Ruggedly built, simply constructed, quick to recharge and equipped with easy-to-operate Trigger Finger Control, *Kidde* Dry Chemical Extinguishers mean sure death to fire—and extra safety for you.

Kidde Dry Chemical Extinguishers can be used in normal standing position, just pick unit up, point the horn, pull the trigger.

Streamlined diffuser horn gives better discharge pattern, means greater coverage, insulating blanket for the operator.

Kidde

CHECK YOUR FIRE EXTINGUISHER BY Wednesday, October 11

Kidde

Walter Kidde & Company, Inc., 1054 Main Street, Belleville 9, N. J.
In Canada: Walter Kidde & Company, Ltd., Montreal, P. Q.

STEAM POWER

The above photo shows five 150 H.P. 350 lb. W.P. Lucey Boilers mounted on a Richardson & Bass (Louisiana Account) drilling barge. Installation was made in May, 1949.

DISTRIBUTORS:

Lucey Products Corporation
Tulsa, Oklahoma

Houston Oil Field Material Co., Inc.
Houston, Texas

Jones & Laughlin Supply Co.
Tulsa, Oklahoma

Murray-Brooks, Inc.
Lake Charles, Louisiana

Bethlehem Supply Co. of California
Los Angeles

EXPORT:

Lucey Export Corporation
233 Broadway
New York 7, N. Y.

Broad Street House, E.C. 2
London, England

Lucey Boilers are approved
for use in Canada

For off-shore or inland drilling, power-wise and economy-minded contractors use LUCEY Inside Seal-Welded and Double Calked BOILERS. Complete sealing off of all possible joint leakage and seepage assures the highest in everyday performance. Lucey Oil Country Boilers are available from 40 H.P. to 150 H.P., with working pressures from 125 lbs. to 350 lbs.

LUCEY

LUCEY BOILER
and MANUFACTURING CORPORATION

Chattanooga, Tenn.

BETHLEHEM SUPPLY CO. OF CALIF.
5000 ALCOA AVENUE, VERNON
LOS ANGELES 58, CALIF.

413 STERLING BUILDING
HOUSTON, TEXAS

A GREAT RECORD THE

110 COMPLETED WELLS, 295,909 FEET OF HOLE
in less than 3 years... with two MURPHY DIESELS
Can you match this drilling record?
23,328 hours of operation for each engine without a major overhaul
Joe Wyant, (left) Drilling Superintendent for Panoma says of his Murphy Diesels: "I have been in the oil business for 21 years and directly connected 100% with drilling operations since 1936. In my past experience I have operated many makes of engines. This is the second Murphy powered rig I have operated and my next engines will be Murphys, too, because making hole is my business."
THE Panoma Corporation (formerly Harrington and Marsh) put their Murphy Diesel powered U-15 Unit Rig with 7½" x 14" mud pump to work drilling gas wells in the Hugoton Field in the Oklahoma Panhandle on February 18, 1946, and by December 23, 1948, had compiled the impressive record of 110 completed wells and a total footage of 295,909 ft. (over 56 miles). This required 23,328 hours of operation for each of the two engines. There were no major overhauls on the engines and the rig operated 972 out of a possible 1040 days, the only down time being caused by vacations and bad weather—none due to engine failure! Fuel consumption was about 1500 gallons per well including fuel for stoves and washing up. And as the tabulated for stoves and washing up. And as the tabulation at the left shows, the Murphys made more hole in their third year than they did in their first two!
Here's a record of dependability and economy that's hard to beat but it reflects the experience of owners everywhere. Before you repower your existing rigs or invest in new rigs, we'd like to show you how you can make more hole for less money with Murphy Diesel Power. Contact your Murphy Diesel Dealer or write to:
MURPHY DIESEL COMPANY
5305 W. Burnham Street, Milwaukee 19, Wisconsin
OIL INDUSTRY FACTORY BRANCH—Sales, Parts and Service
113-17 South Elwood Street, Tulsa, Oklahoma
MURPHY DIESEL
DUTY POWER FOR THE OILFIELDS

Here's the record

Drilling Record of the Panoma Corporation's Murphy Diesel Powered U-15 Unit Rig				
Period	Feet of Hole Drilled	Days Worked	No. of Wells	No. of Hours
2-18-46 to 12-31-46	84,610'	314	31	7536
2-2-47 to 12-23-47	101,563'	353	38	7992
1-12-48 to 12-25-48	109,736'	325	41	7800
TOTAL [illegible]46 to [illegible]48	295,909'	972	110	23,328

THIS IS THE STORY WE TOLD IN JUNE OF 1949 .....

WHEN we ran the advertisement reproduced above we knew we were presenting an impressive record. But since those engines were still being used, we also knew the record was not complete. Now we can tell the complete story of the service these two Murphy Diesels have given before being overhauled:

Joe Wyant, then drilling superintendent for Harrington and Marsh (later known as the Panoma Corporation), put two 150 H.P. Murphy Diesels to work on February 18, 1946. Between that date and March 16, 1950, when the engines were replaced by a new larger pair of Murphy Diesels, 135 wells were completed totalling 364,916 feet. *The engines piled up a total of 28,728 hours each without a major overhaul!* During this entire period, no down-time was caused by engine failure. There were times when the rig was not used because of vacations, bad weather or because the rig was stacked. This is the kind of performance that puts more profits into drilling. But even this does not represent "the end" of these two engines. One has already been rebuilt and is back in service for another driller and the second is in the process of being rebuilt. Both will still give thousands of hours of dependable service.

Joe Wyant, who since June 14, 1949, has operated the rig under his own ownership, is even more enthusiastic about the two new Murphy Diesels than he was about the original pair. As Mr. Wyant puts it, he has all of the economy and reliability of the original pair plus all the advantages of the new improved engines.

No driller can afford to overlook performance like this. Make it a point to talk to your Murphy Diesel Dealer about what Murphy Diesel Power can do for you. Be sure to ask for a copy of the booklet *"10 Questions to Ask a Diesel Engine Salesman"* or write direct for a copy.

MURPHY DIESEL COMPANY

5305 W. Burnham St. Milwaukee 14, Wisconsin

OIL INDUSTRY FACTORY BRANCH Sales, Parts and Service: 113-117 South Elwood Street, Tulsa, Oklahoma

Sales, Parts and Service: Los Angeles, California; Evansville, Indiana; Great Bend, Kansas; Monroe, Louisiana; Tulsa, Oklahoma; Amarillo, Dallas, Houston, Odessa and San Antonio, Texas; and Edmonton, Alberta, Canada.

MURPHY DIESEL

HEAVY DUTY POWER

Engines and Power Units: 90 to 220 H.P.

an even better one now!

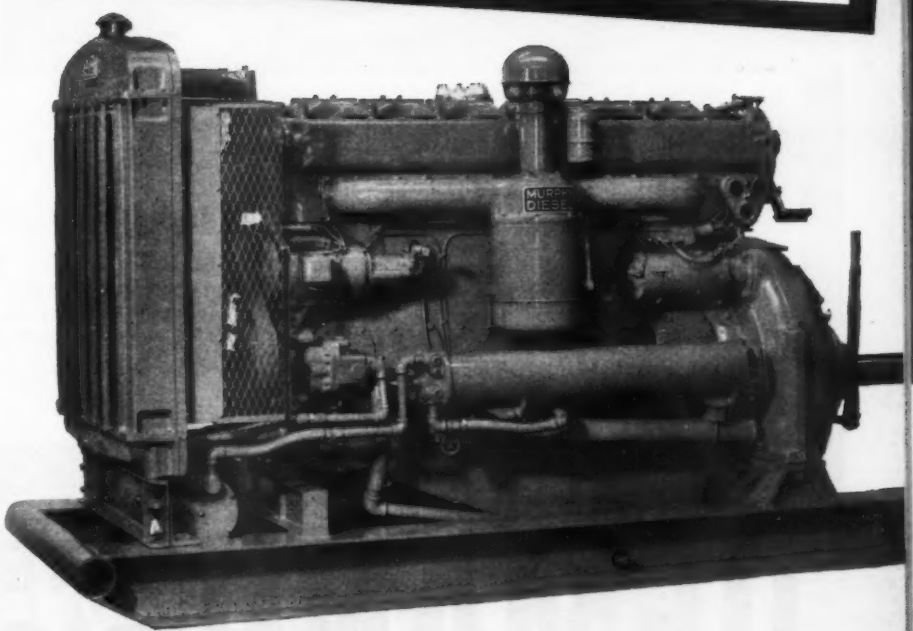
Joe Wyant (above), with over twenty years in the oil business, knows drilling and knows engines from experience. That's why he's a Murphy booster.

Drilling Record of Joe Wyant's pair of 150 H.P. MURPHY DIESELS

- ✓ 135 completed wells
- ✓ 365,916 ft. of hole
- ✓ 1197 working days
- ✓ 28,728 hours per engine without a major overhaul

and now . . . another rig powered by MURPHY for Joe Wyant

WHEN Joe Wyant put a second rig to work March 2, 1950, you can be sure it was Murphy powered. The new rig, designated as No. 2, is a Unitrig Model U-15 with a 7¼" x 14" Ensco Duplex Mud pump. In less than four months of drilling in Grant County, Kansas, it has completed 18 wells totalling 43,032 ft. It looks like the start of another enviable Murphy Diesel record.



Illustrated is a Murphy Diesel Model 22, rated at 165 H.P. continuous, 180 H.P. for hoisting. Twenty-four Murphy Diesel models are available, ranging from 90 to 220 H.P., 1200 and 1400 RPM, diesel and dual-fuel, also crude oil engines.

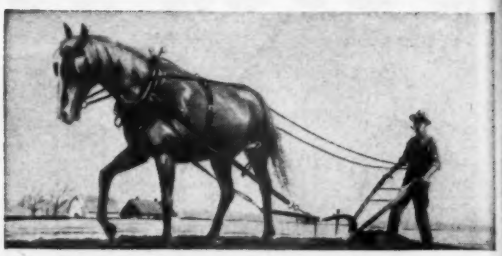
FOR THE OILFIELDS

Generator Sets: 60 to 133 K.W., A.C. or D.C.

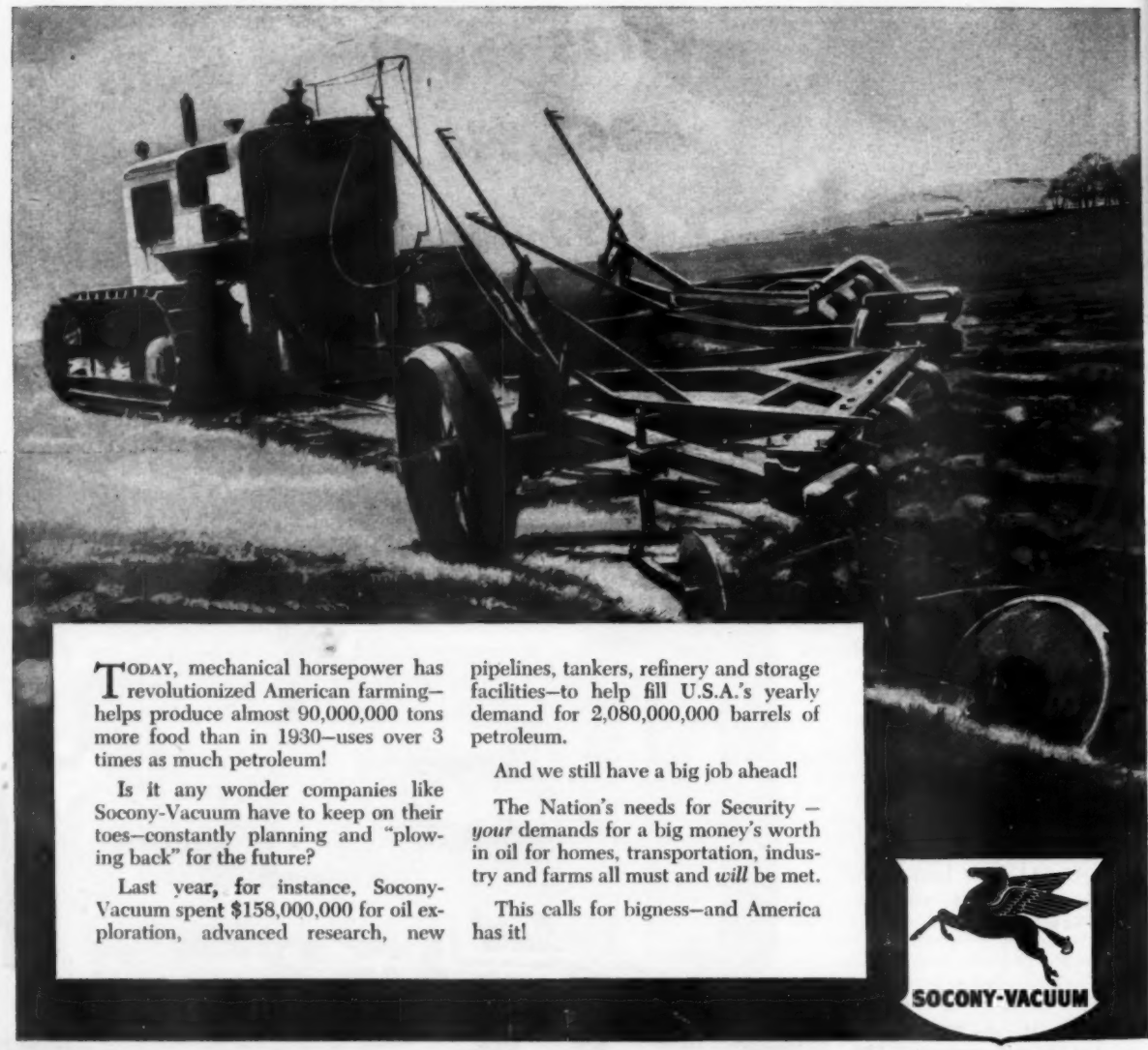
MURPHY DIESEL

XUM

DOBBIN



DOESN'T WORK HERE ANY MORE!



TODAY, mechanical horsepower has revolutionized American farming—helps produce almost 90,000,000 tons more food than in 1930—uses over 3 times as much petroleum!

Is it any wonder companies like Socony-Vacuum have to keep on their toes—constantly planning and "plowing back" for the future?

Last year, for instance, Socony-Vacuum spent $158,000,000 for oil exploration, advanced research, new pipelines, tankers, refinery and storage facilities—to help fill U.S.A.'s yearly demand for 2,080,000,000 barrels of petroleum.

And we still have a big job ahead!

The Nation's needs for Security — *your* demands for a big money's worth in oil for homes, transportation, industry and farms all must and *will* be met.

This calls for bigness—and America has it!

SOCONY-VACUUM

DEMAND DETERMINES BIGNESS

The Flying Red Horse Companies: SOCONY-VACUUM OIL COMPANY, INC., and Affiliates:

MAGNOLIA PETROLEUM COMPANY • GENERAL PETROLEUM CORPORATION

consider this OUTSTANDING ADVANTAGE of the famous WHELAND SWIVEL

WASH PIPE, special nickel alloy steel, carburized, precision machined, wearing surface heat treated to 700 Brinnell hardness, precision ground, polished and honed for maximum smoothness and minimum packing wear. Wash pipe outside diameters are precision machined in one operation assuring perfect concentricity and perfect alignment. No place to form pockets or restrict mud flow.

Wash pipes can be replaced with minimum time and effort. With just average care, the replacement goes in EASILY and in PERFECT ALIGNMENT.

ALSO IMPORTANT: Pressure lubricated, chevron type, controlled stack height, wash pipe packing in extra deep stuffing box. Free flexing packing lips provide positive mud seal. Triple lower grease seal. All packings permanently adjusted, pressure grease lubricated through readily accessible fittings.

All bearings have capacity in excess of Wheland's capacity ratings. Timken main load bearing with radial and thrust above and below to maintain perfect stem alignment. Upper thrust bearing, tapered cone. All bearings positively sealed off from mud and run in circulated, cooled oil. Large oil capacity.

Long radius gooseneck, streamlined manganese vanadium steel body, positive lower grease seal, special hold down construction, freedom from adjustments.

4 WHELAND SWIVEL SIZES

Model E-7000—Capacity 464,300 lbs. at 100 R.P.M.
Model E-6600—Capacity 350,000 lbs. at 100 R.P.M.
Model E-6200—Capacity 262,000 lbs. at 100 R.P.M.
Model E-6100—Capacity 130,000 lbs. at 100 R.P.M.

Bulletin No. 173 sent on request gives details, shows why more and more people are saying: "WHELAND has the best swivel on the Market."

Ask your Jones & Laughlin Supply Man

WHELAND

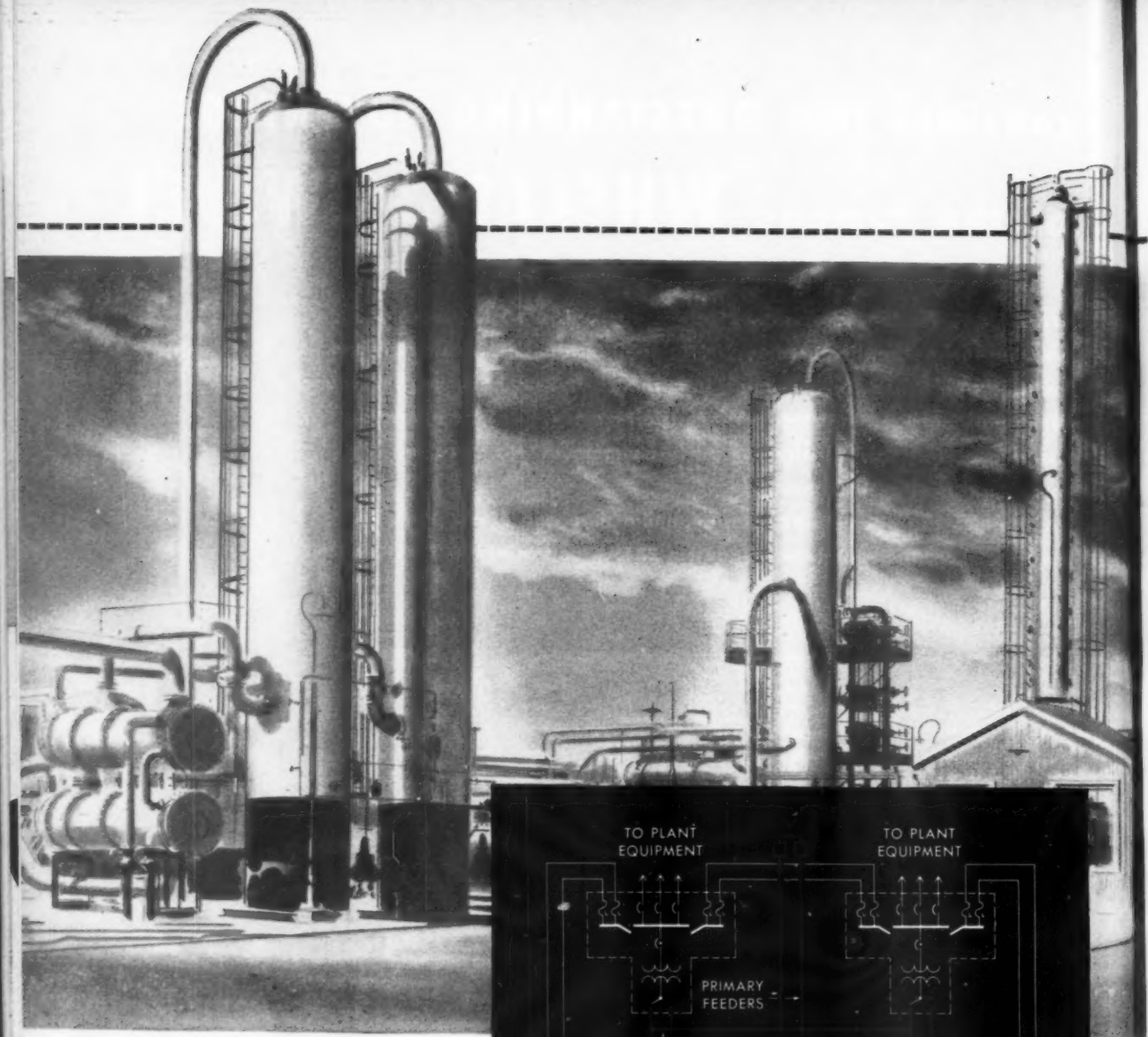
THE WHELAND COMPANY, CHATTANOOGA, TENN., U. S. A.
ROTARY DRILLING MACHINERY

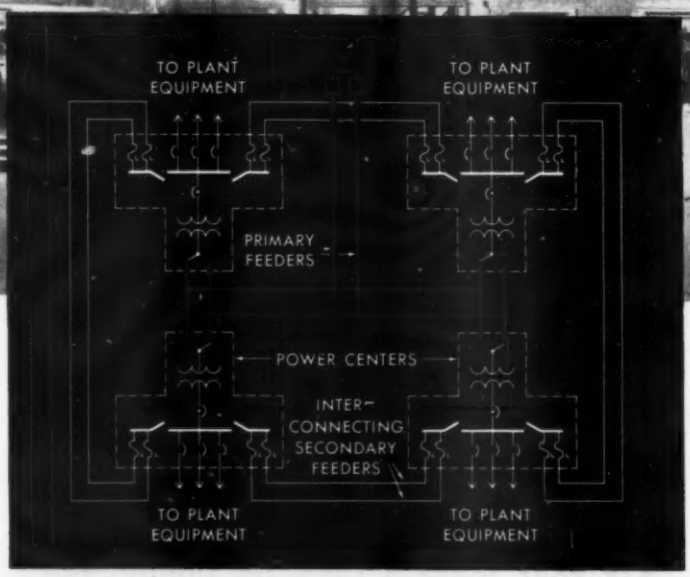
DOMESTIC DISTRIBUTORS
Jones & Laughlin Supply Co.
Tulsa, Oklahoma
Stores and Offices in all Principal Oil Fields and Centers

EXPORT DISTRIBUTORS
Lucey Export Corporation
233 Broadway,
New York 7, N. Y.
Broad Street House
London E.C. 2, England

DRAW WORKS • SLUSH PUMPS • ROTARIES • SWIVELS • CROWN BLOCKS • TRAVELING BLOCKS

XUM





PRIMARY SELECTIVE NETWORK SYSTEM

This system rates high on service continuity and flexibility. Two Primary Feeders supply power. If a fault occurs on one, the other Feeder takes over to keep service continuous. If a fault occurs in a Power Center, its section of the plant is supplied by the adjacent Power Centers through the interconnecting Secondary Feeders.

When additional power is needed, one Primary Feeder supplies the plant while a new Power Center is connected to the dead feeder. The plant keeps operating.

This is one of eleven basic systems, all with varying characteristics. Let experienced Westinghouse engineers help you plan the system best fitted to *your* operations.

Westinghouse

EQUIPMENT FOR THE PETROLEUM INDUSTRY

YOU CAN BE **SURE**.. IF IT'S

Westinghouse

HOW MUCH DOES IT COST

when a distilling column goes "down"?

Probably more than you care to think about. But when power failure is at fault this costly threat can be eliminated. The answer:

A planned power distribution system!

When you modernize existing plants or build new ones, plan a system that *insures* service continuity . . . that gives you *alternate* power routes when electrical troubles occur. Moreover, make sure the system will be flexible . . . to permit load shifts and allow expansion without shutdown.

The Primary Selective Network shown on the opposite page is an example of a system that gives you this important service continuity and flexibility. But this is just one of the many systems you'll want to consider. Each has specific advantages depending on your particular operation. And Westinghouse can help you and your plant contractor design the system that *best* fits your requirements.

To help you make preliminary decisions we've prepared informative material covering all systems. Write for yours now. And remember, when you're building or modernizing, call in your Westinghouse engineers. With wide experience in power problems they can help you plan the one best system for your particular operation. J-94855

HERE'S REAL HELP FOR YOUR SYSTEM PLANNING

"Industrial Plant Distribution Systems": 34 fact-filled pages completely explain the eleven basic systems. Ask for B-4045.

A System Selector: pocket-sized selector card quickly shows the characteristics of each type.

A Full-Color Movie: sound movie dramatizes the economies of system planning. Ask your Westinghouse representative for a free showing.

Get this valuable information now. Call your Westinghouse office or write: Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

XUM

It's the Nash!

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs. pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

Nash simplicity means low maintenance cost, with original pump performance constant over long periods. Data on these pumps sent immediately on request.

No internal wearing parts.

No valves, pistons, or vanes.

No internal lubrication.

Low maintenance cost.

Saves floor space.

Desired delivery temperature automatically maintained.

Slugs of liquid entering pump will do no harm.

75 pounds in a single stage.

NASH ENGINEERING COMPANY
322 WILSON, SO. NORWALK, CONN.

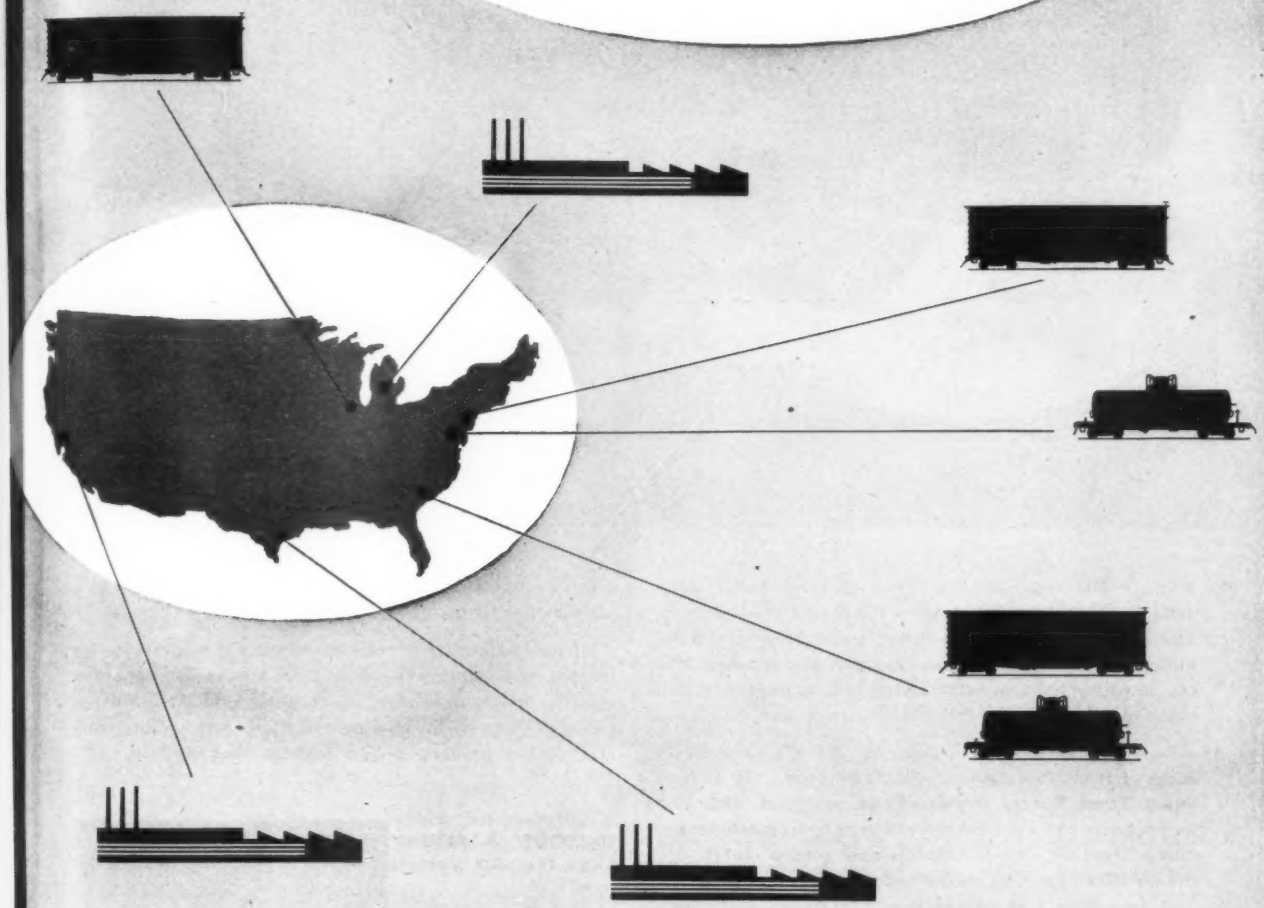
XUM

Dow Caustic Soda

serves industry

. . . with unequalled distributing facilities

1. Three producing plants—in Michigan, Texas and California.
2. Caustic Soda Solution bulk tank terminal distributing facilities—Carteret, N. J. and Charleston, S. C.
3. Caustic Soda Solid, Flake and Ground Flake terminal distributing facilities—Chicago, Ill., Charleston, S. C., and Port Newark, N. J.



THE DOW CHEMICAL COMPANY
MIDLAND, MICHIGAN

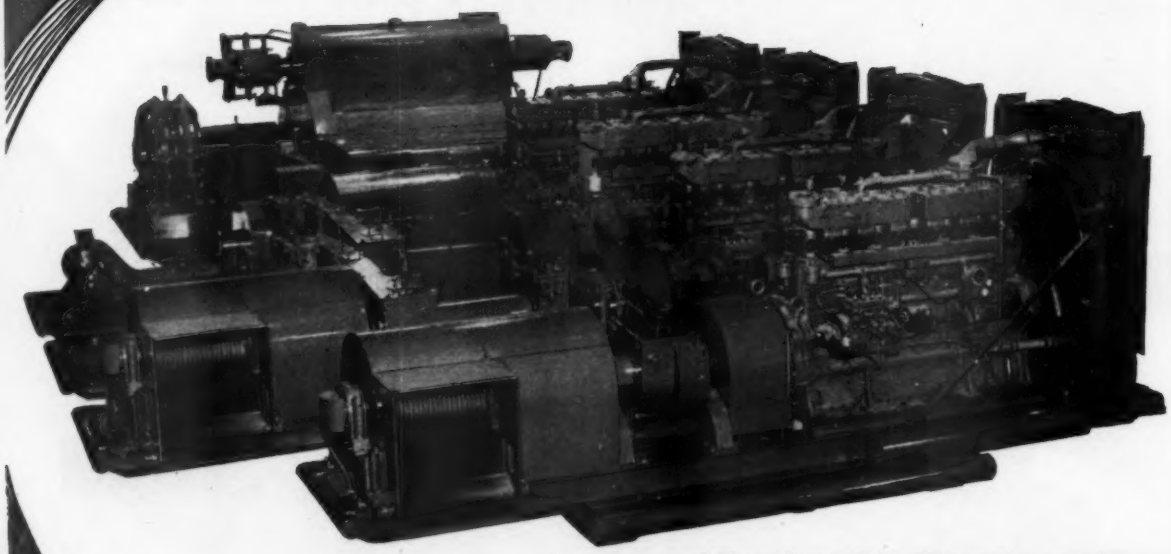
New York • Boston • Philadelphia • Washington • Atlanta • Cleveland • Detroit • Chicago
St. Louis • Houston • San Francisco • Los Angeles • Seattle
Dow Chemical of Canada, Limited, Toronto, Canada

DOW
CHEMICALS
INDISPENSABLE TO INDUSTRY AND AGRICULTURE

XUM

For DRILLING to 18,000 ft.

USING 4½ IN. DRILL PIPE



Wilson Super Titan Rotary Drawworks is WAUKESHA-POWERED 4-Engine Rig

● It's a BIG rig—SUPER POWERED for really deep drilling—with four fast flexible Waukesha Power Units. They're smooth and responsive, these Model 6-LROU units—6 cylinder, 8½ x 8½ in. bore and stroke, 2894 cu. in. displacement—developing an aggregate maximum of 1600 horsepower burning natural gas.

Recommended by its makers for drilling to a maximum of 18,000 feet, using 4½ inch drill pipe, the Wilson Super Titan Rotary Drawworks is equipped with two pump drives and a double rotor 40 inch hydromatic brake. Pump clutches, master clutch and rotary clutch are the air tube type. Drum and transmission and catheads are air controlled and the four Waukesha Power Units are equipped with air throttle controls.

Oil field reliability is built into these big 6-LROU units —with removable wet sleeve cylinders, using separate cylinder heads mounting spark plugs and large valves; seven 4¼ in. main bearings; full pressure oiling and every other modern design feature. Get Bulletin 840.

Left (carburetor) side
MODEL 6-LROU
gas or gasoline power unit.

WAUKESHA
OIL FIELD POWER

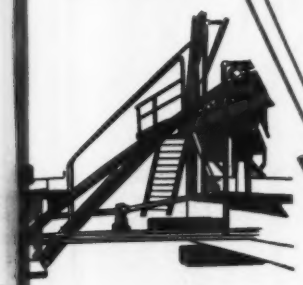
WAUKESHA MOTOR COMPANY, WAUKESHA, WIS. • NEW YORK • TULSA • LOS ANGELES

Relieve the Strain with

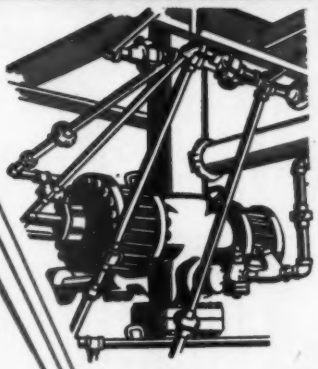
UNIBOLT FLEXI-BALL JOINTS

ROTARY HOSE—
STANDPIPE END

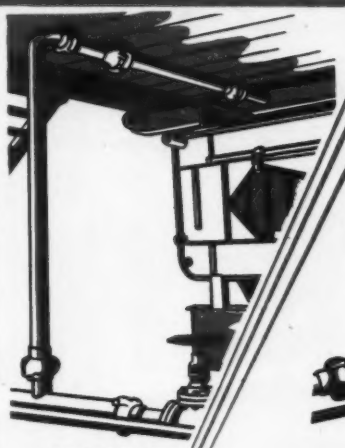
ROTARY HOSE—
SWIVEL END



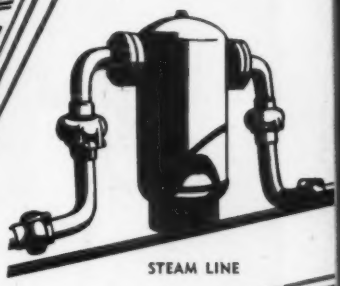
MUD LINES



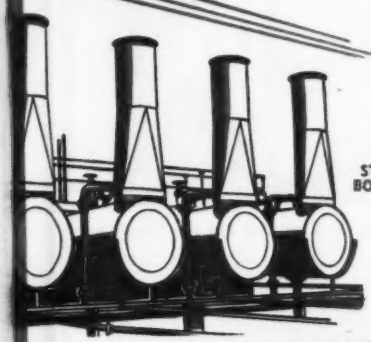
PRESSURE OPERATED
BLOWOUT PREVENTER
MANIFOLD



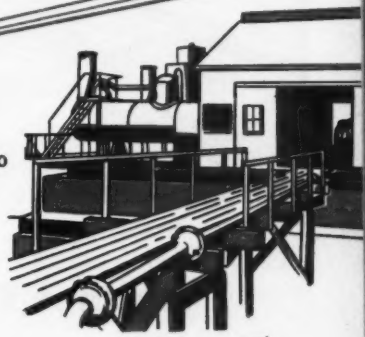
STEAM LINE
SUBJECTED TO
VIBRATION



STEAM LINE



STEAM LINE
BOILER DROPS



STEAM LINE—
BOILER BARGE TO
DRILL BARGE

The Flexi-Ball Joint, which provides for misalignment up to 38 degrees, depending on the size of the joint, is designed to relieve piping of stress caused by expansion, vibration, or misalignment. It is a "natural" for flexible manifolds.

The proven UNIBOLT coupling principle is employed to join the component parts of this fitting. As a result, trouble due to galling and freezing of threads is entirely eliminated by the Flexi-Ball design. It is assembled by the simple process of tightening one bolt with an end wrench. Even after extended periods of service, the joint can be quickly dismantled by releasing the bolt.

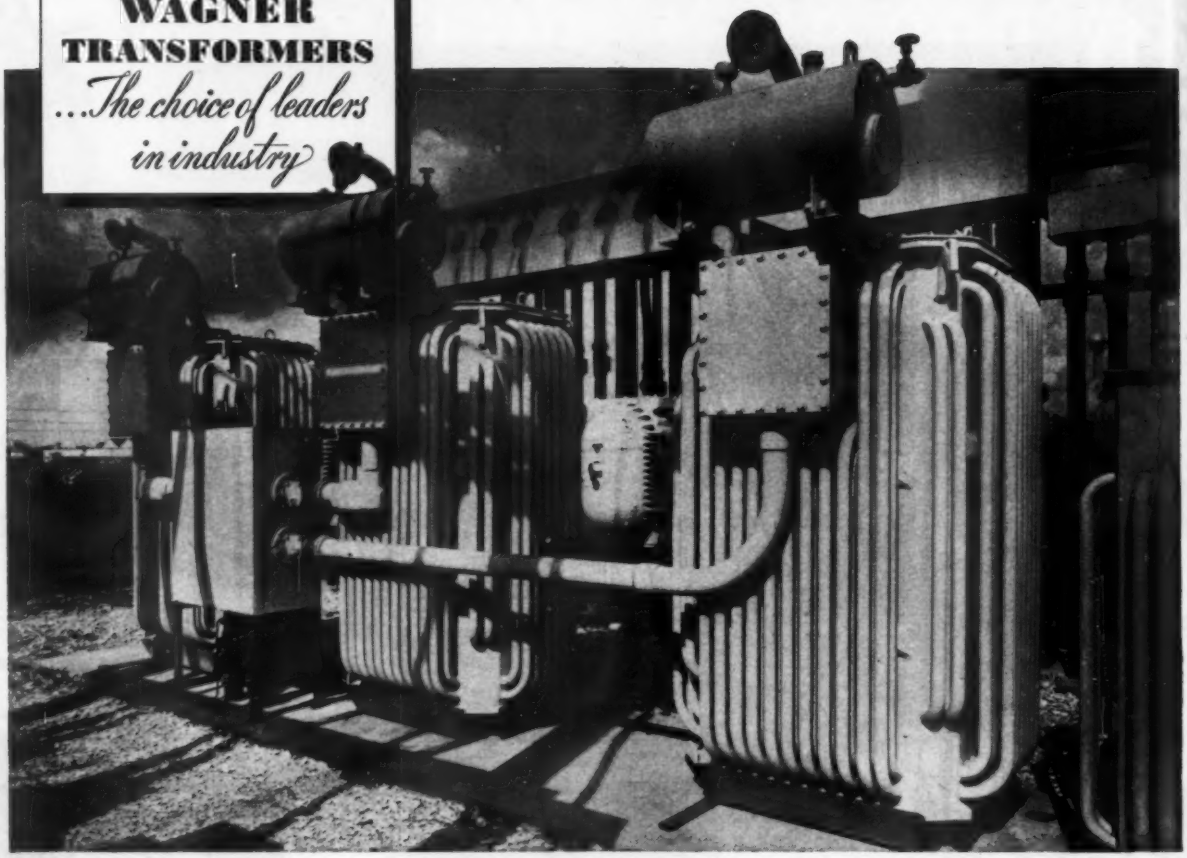
This fitting may be used safely in any service, since it is made in steel only. Its sizes range from 1½" to 6" and test pressures to 6000 lbs., depending on size; 500 lbs. steam working pressure.

THORNHILL-CRAVER CO.

HOUSTON, UNIBOLT **TEXAS**

XUM

WAGNER TRANSFORMERS
...The choice of leaders in industry



Bank of 667 kva, 1 phase, 60 cycle, 2400 to 480 volt Transformers

Wagner Transformers power the production of Rohm & Haas "Chemicals for Industry"

Production of "Chemicals for Industry" by the Rohm and Haas Company, makers of famed Plexiglas, is not a simple one-plant operation. The products of one of their plants may have no resemblance to the commercial products into which they are integrated at another plant. The natural raw material found in Texas, for instance—the processed chemicals manufactured there—and Plexiglas, an end product manufactured in another plant—are all part of a great modern production chain.

Power for production—with Rohm and Haas as with any modern industry—is provided by electricity. The manufacture of chemicals in the Rohm and Haas plant in Deer Park, Texas, is powered by Wagner Transformers and Wagner Motors. Wagner transformers in the main substation take energy at 69,000 volts and feed it to the low voltage substation at 2400 volts. The low voltage substation of Wagner transformers (illustrated above) in turn furnishes 480 volts to motors and to small air-cooled Wagner transformers which furnish 120 volts for lights and other single phase loads.

Thirty-one branch offices, located in principal cities, are ready to help you whenever you have a transformer problem. Users of Wagner Transformers also benefit by nationwide service facilities. Write for Bulletin TU-180 and TU-181 for full information on Wagner Power and Distribution Transformers.

WAGNER ELECTRIC CORPORATION
6389 Plymouth Ave., St. Louis 14, Mo., U.S.A.

Wagner Electric Corporation
EST. 1891

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS — AIR AND HYDRAULIC

BRANCHES IN 31 PRINCIPAL CITIES

Canada's GIANT NEW PIPE LINE...

▲ Koppers Bitumastic Enamel being machine-applied.

▼ When completed, this giant line of the Interprovincial Pipe Line Company will carry oil from Edmonton, Alberta, to Winnipeg, Regina and tankers on the Great Lakes. It will require 64,330,000 gallons of oil to fill this line.

protected by KOPPERS BITUMASTIC ENAMEL

● From one end to the other, the new 1,150-mile line of the Interprovincial Pipe Line Company will be protected against corrosion by Koppers Bitumastic® 70-B Free-Flowing Enamel. This giant outlet will carry the production of Alberta's oil fields to Winnipeg, Regina and Ontario markets.

Koppers Bitumastic 70-B Enamel, machine-applied over a coat of Koppers Bitumastic 70-B Priming Solution, will protect 450 miles of 20″ pipe, 340 miles of 16″ pipe, and 360 miles of 18″ pipe. Highly-corrosive soils, river crossings, cold weather—all types of rugged conditions—will test the effectiveness of the protective coating.

Many of America's pioneer oil and gas pipe lines—laid in the twenties—are still giving good service today, thanks to the effective protection of Koppers Bitumastic Enamels. And hundreds of applications of Koppers Bitumastic Enamels have given Koppers engineers unequalled experience in pipe-line protection—experience that can help you.

Give your pipe lines *assured* protection against corrosion by specifying "Koppers Bitumastic Enamel." Get in touch with your Koppers representative for complete details and estimates.

Why Bitumastic Enamels give lasting protection

Processed from a base of coal-tar pitch, they are impervious to moisture . . . chemically resistant to soil elements. They make a tight bond with the pipe . . . do not disintegrate with age . . . maintain continuously high electrical resistance.

KOPPERS BITUMASTIC ENAMELS
REG. U.S. PAT. OFF.

KOPPERS COMPANY, INC., Tar Products Division, Dept. 1003T, Pittsburgh 19, Pa.

Stabilize YOUR DRILL STRING

- **INCREASE DRILLING WEIGHTS**
- **ELIMINATE DRILL PIPE WHIP**
- **MAKE FULL GAGE HOLE**
- **ELIMINATE BIT WOBBLE**

When the new Security Reamer-Stabilizer is run between drill collars, it not only insures clean full gage hole, but provides unexcelled drill string stabilization. With three barrel-shaped cutters contacting over a third of the wall circumference at all times, this new tool acts as a large roller bearing, absorbing and transmitting to the formation all forces tending to start drill stem whip and rock bit gyration.

The result of running the Security Reamer-Stabilizer is a smooth drilling string to which weight may be added *without* the usual undesirable effects. Drilling can proceed at a faster rate and the time for the entire drilling operation is reduced appreciably.

LOOK AT THESE NEW FEATURES

- **Extra rugged body sections throughout.**
- **Heavy ribs between cutters give maximum strength in torque and bending.**
- **Barrel-shaped cutters provide proper bearing surfaces for efficient stabilization.**
- **Open pockets and directed return circulation keep cutters clean.**
- **Cutters retained in body by exclusive locking device.**

Ask your Security Field Representative about this new Reamer-Stabilizer.

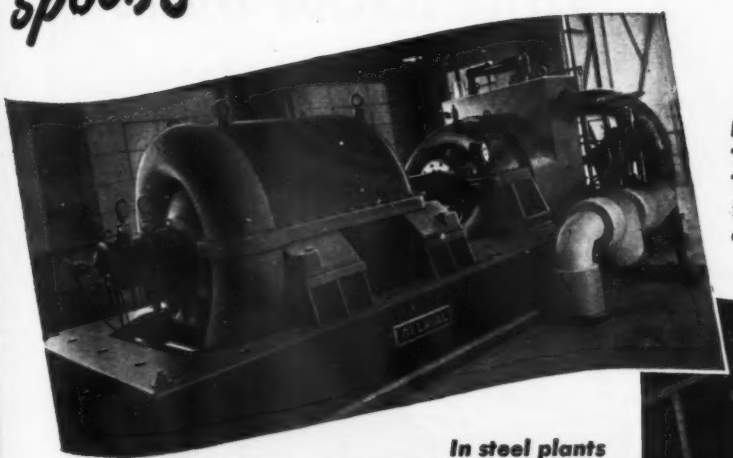
Security
HOLE OPENER

ROCK BITS • CORING BITS • REAMERS • CASING SCRAPERS • SECURALO

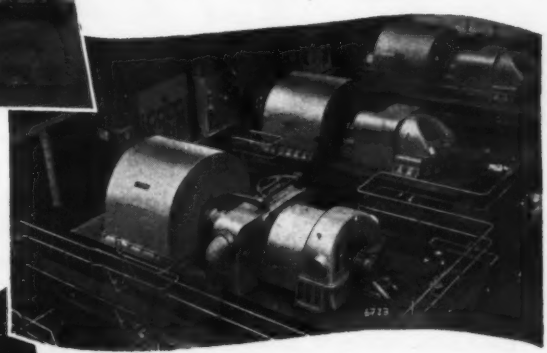
SECURITY ENGINEERING CO., INC.
ONE OF THE DRESSER INDUSTRIES

Main Office: Whittier, California
Branches in all major producing areas.
Export Office: Chanin Building, New York City

for Continuous Operation specify De Laval heavy Duty Blowers!

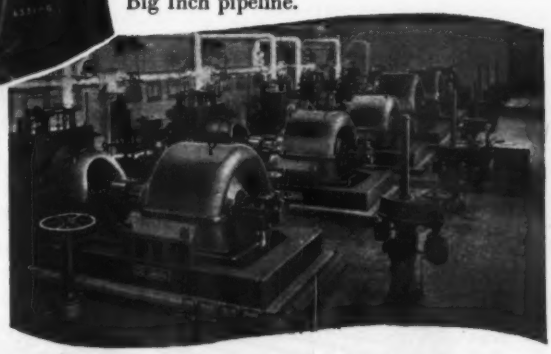


In refineries
This 1910 hp, 17,800 cfm De Laval Turbine Driven Blower supplies air for catalyst regeneration in a fluid catalytic cracking plant.



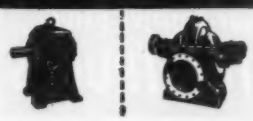
In steel plants
These three De Laval Blast Furnace Blowers serve one of America's leading steel plants—the largest unit is rated at 123,00 cfm against 33.3 psig. The other two are rated at 97,800 cfm each.

On pipe line service
This De Laval single-stage compressor pumps gas through the Little Inch pipeline at 850 psi. Similar De Laval units also are giving continuous trouble-free service at this high pressure on the Big Inch pipeline.



In gas plants
Three De Laval coke oven boosters and three coke oven exhausters installed in an Eastern Steel Mill. Send for catalog 05-16-OG.

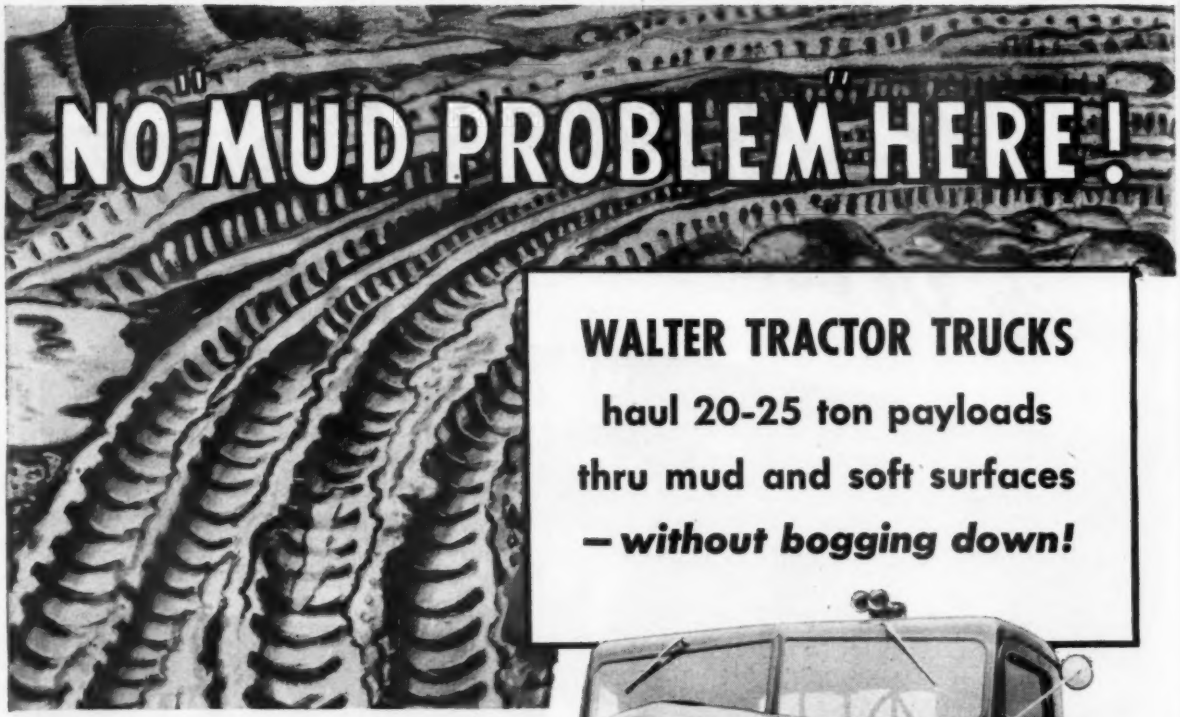
DE LAVAL



DE LAVAL STEAM TURBINE CO.
TRENTON 2, N. J.

C-16

XUM



WALTER TRACTOR TRUCKS
haul 20-25 ton payloads
thru mud and soft surfaces
—without bogging down!

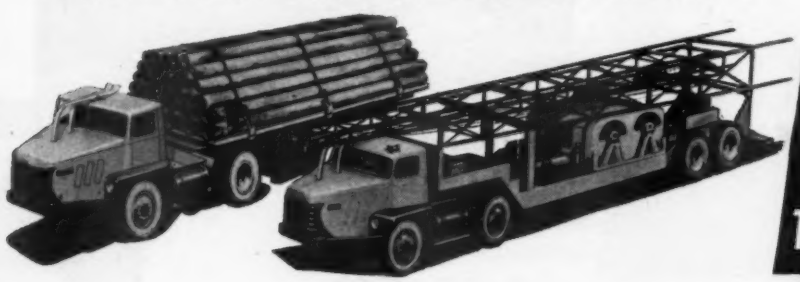
Possible only with the Super Power and Traction of FOUR POINT POSITIVE DRIVE

Mud in drilling is valuable. But mud in *hauling* is costly. Especially when it delays or stops transportation of rigs and supplies—restricts size of loads—hampers operations—adds to the cost of production.

These handicaps can be eliminated. Mud, sand, soft or slippery surfaces are no problem to Walter Tractor Trucks. These giant, specially designed trucks provide never-failing, non-slip traction in four driving wheels, under all conditions. Combined with properly designed semi or pole trailers, they haul huge loads to any off the road location . . . yet meet legal width and weight limitations on the highway.

Write for full details on the Walter Tractor Truck-Trailer method of oilfield hauling. We'll send you figures and specifications showing how you can step up loads, speed up hauling and cut down costs.

WALTER MOTOR TRUCK COMPANY
1001-19 Irving Ave., Ridgewood 27, Queens, L. I., N. Y.



WALTER
4-POINT POSITIVE DRIVE
TRACTOR TRUCKS

Check list for line men

Before you select any line pipe, check to see if the answer is yes to all these questions:

- ✓ **Is it manufactured under rigid quality controls—from the mining of coal and ore to production of finished pipe? (Kaiser Steel pipe is!)**
- ✓ **Is it produced by modern facilities? (Kaiser Steel pipe is!)**
- ✓ **Is it manufactured in a complete range of sizes? (Kaiser Steel pipe is available in diameters up to 30 inches and in lengths up to 40 feet!)**

As a major supplier of line pipe to the Western two-thirds of the nation, Kaiser Steel can answer *yes* to every question! That's why experienced line men know this is true:

It's good business to do business with

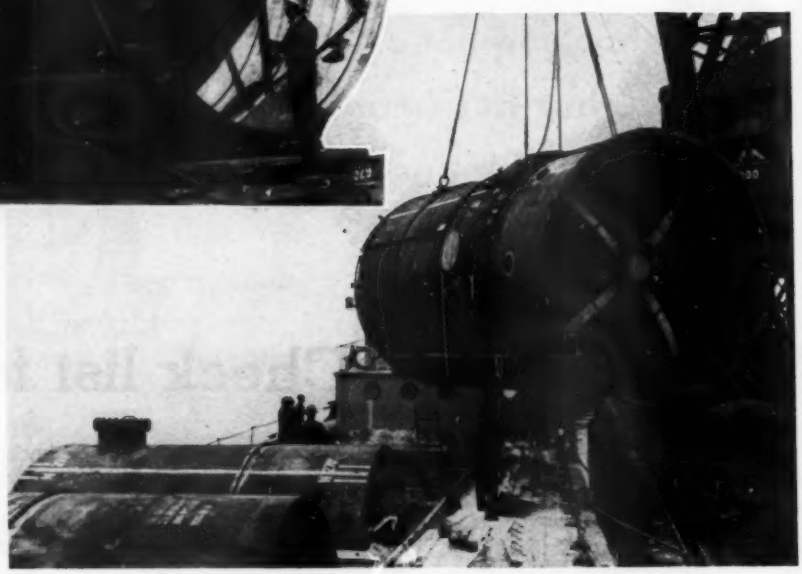
Kaiser Steel

KAISER STEEL PIPE SPECIFICATIONS • All pipe manufactured to latest A.S.T.M. and A.P.I. specifications

Type	Diameter	Length	Wall Thickness	Shipping Point
Continuous Weld—Threaded and Coupled	½" to 4" nominal I.D.	Uniform 21'	Standard	Fontana, Calif.
Continuous Weld—Plain End	2⅜" to 4½" O.D.	Up to 40'	Standard	Fontana, Calif.
Electric Resistance and Fusion Weld—Plain End	8⅝" to 22" O.D.	Up to 40'	.188" to .500"	Napa, Calif.—Basalt-Kaiser
Electric Resistance Weld—Plain End	5⅛" to 12¾" O.D.	Up to 55'	.188" to .400"	Fontana, Calif.
Electric Fusion Weld—Expanded—Plain End	24" to 30" O.D.	Up to 40'	.188" to .500"	Napa, Calif.—Basalt-Kaiser

Prompt, dependable delivery at competitive prices • KAISER STEEL CORPORATION Los Angeles, Oakland, Seattle, Portland, Houston, Tulsa, New York

DIRECT WATER OR RAIL SHIPMENTS



BUILDERS OF HEAVY EQUIPMENT

Sections of a synthetic-crude column are shown being loaded at one of the deep water piers of the company for shipment to Perth Amboy, New Jersey. This 90-foot high column was a part of recent production at Newport News that has included both a hot and a cold catalyst hopper, fractionator tower, reactor, and other items for the chemical and petroleum industries.

The wide range of large facilities in the 225-acre Newport News plant are particularly suited for the production of heavy equipment. Constant investigation keeps the plant abreast of the developments in manual and automatic welding methods. Modern radiographing instruments and large stress-relieving ovens are included in the plant facilities. Your inquiries are invited.

BUILDERS OF EQUIPMENT FOR CHEMICAL, PETROLEUM AND PETRO-CHEMICAL INDUSTRIES

NEWPORT NEWS
SHIPBUILDING AND DRY DOCK CO.
NEWPORT NEWS, VIRGINIA

PB Relieved End CASING PROTECTORS

... give extra shock and tear resistance where it's needed most!

1. RUGGED! PB's *relieved end* design puts extra grip in the center—takes the stress off the ends—*gives extra shock and tear resistance where it's needed most.* PB's field proven rubber holds up under the toughest drilling conditions—withstands deepest drilling temperatures!

2. SPEEDS UP DRILLING. Field records show that PB Protectors cut friction, torque and power waste . . . allow higher drilling speeds . . . permit more accurate control of weight on the bit.

3. FULL PROTECTION for your drill pipe and casing. *Sure grip* PB Protectors stay as installed—will not slip.

Write today for 1950 catalog.

PB casing protectors installed from transfer sleeve to drill pipe in less than 4 seconds!

Our man can install PB Protectors while you make up or run pipe. No down-time while adding protectors—big savings for the rig operator!

Call your local PB representative today for a demonstration of this faster hydraulic installation equipment—available only with PB.

PB

23 YEARS OF SERVICE TO THE OIL INDUSTRY

Patterson-Ballagh

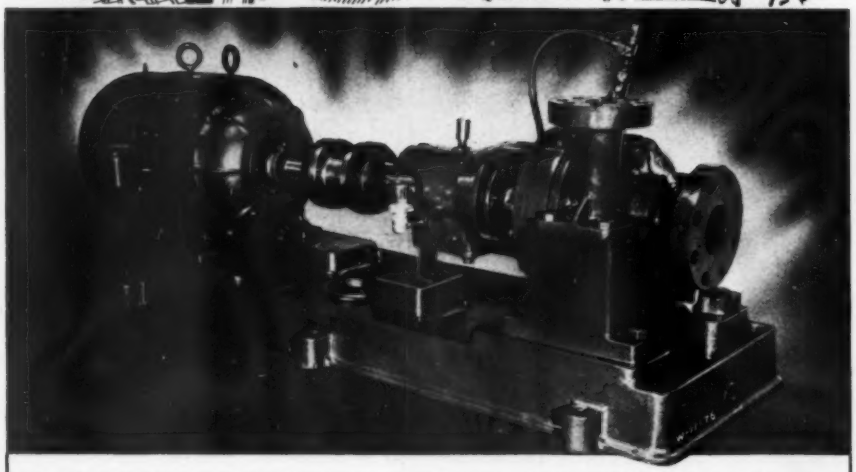
Division of Byron Jackson Co.

MAIN OFFICE: 1900 East 65th Street
Los Angeles 1, California

They ALL Go For

THE TYPE HM!

Worthington's New Process Pump a Hit With Refinery Men, From Operators to Management



A TRULY VERSATILE PROCESS PUMP! The Worthington Type HM Centrifugal is available with conventional packed box or mechanical seal, in capacities up to 650 gpm, heads up to 475 ft. and in a wide choice of materials — cast iron, bronze, stainless steel, carbon steel and Worthite.

Seldom has any pump received so hearty a welcome at all levels of refinery organization as Worthington's Type HM.

Operators like its ruggedness and thorough dependability.

Storekeepers find its maximum interchangeability of parts saves time.

Maintenance men praise its quick adaptability to either a packed stuffing box or mechanical seal, its spacer type coupling that allows removal of the rotor assembly without disturbing piping or driver, and its over-all simplicity of construction that assures such easy inspection and repair.

Engineers and power plant men are impressed by its correct hydraulic and mechanical design, low NPSH and power requirements, and sustained high efficiency.

Management realizes that the long life, low cost upkeep and versatility of the Type HM mean a first class capital investment for present and future process pumping.

GET ALL THE FACTS

Contact our nearest District Office or write direct for Bulletin W-341-B14. Learn why the Type HM is still further proof that *there's more worth in Worthington*. *Worthington Pump and Machinery Corporation, Centrifugal Pump Div., Harrison, New Jersey*

SEE OUR CATALOG IN THE COMPOSITE CATALOG

MEMBER

THE WORLD'S BROADEST LINE ASSURES YOU THE RIGHT PUMP FOR EVERY JOB

WORTHINGTON

CO-3

Types HR and HB. Twenty sizes. Capacities up to 1800 g.p.m. Developed heads up to 900 ft. Proper selection of material permits use for temperatures for below zero to 800°F., for pressures from high vacuum to

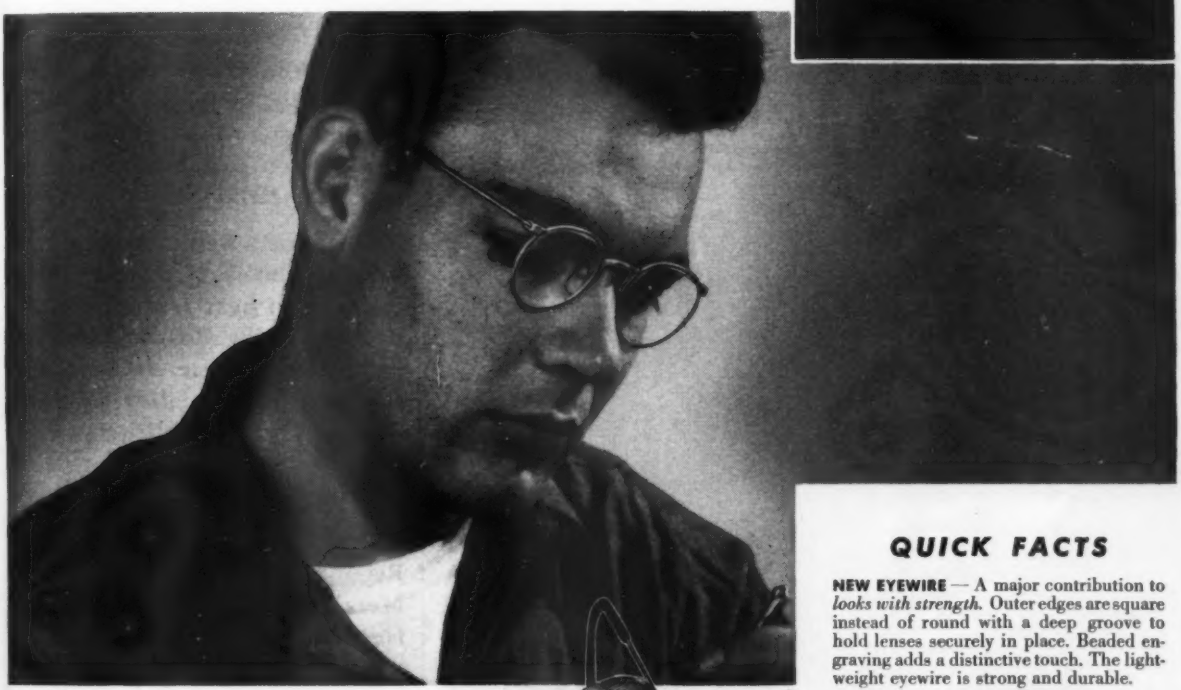
Type HD. Hydraulically-balanced, double-suction impeller handles boiling liquids with low submergence. Capacities range from 600 to 3800 g.p.m. at heads up to 700 ft., temperatures up to 850°F., pressures up

Type WH. High-pressure, high-temperature, centrifugal hot-charge pumps. Twelve distinct points of superiority, based on years of experience building pumps for high pressures and temperatures. Capacities to 3000 g.p.m., heads to 1000 ft.

Type HL. Several construction arrangements permit flexibility in application. Designed for temperatures up to 225°F., or higher with water-jacketed stuffing box. Capacities up to 1600 g.p.m., heads to 500 ft.

You asked for it... HERE IT IS—

AO's New Metal Ful-Vue Safety GOGGLE!



HANDSOMER IN APPEARANCE • STRONGER IN STRUCTURE

With the introduction of the F4100 Metal Ful-Vue, AO's protection against the impact of flying particles reaches its highest development. Here in one goggle, with or without side shields, workers can obtain the peace of mind which comes from assured safety . . . the utmost in comfort over nose and temples . . . the very finest in EYE APPEAL PLUS EYE PROTECTION!

QUICK FACTS

NEW EYEWIRE — A major contribution to *looks with strength.* Outer edges are square instead of round with a deep groove to hold lenses securely in place. Beaded engraving adds a distinctive touch. The lightweight eyewire is strong and durable.

NEW RUGGED ENDPIECE—Streamlined . . . with a wide bearing surface at hinge which minimizes temple drop. Screw heads are countersunk and flush with endpieces for added good looks, non-sagging security.

NEW LIGHTWEIGHT TEMPLE—Oval temples instead of round for greater comfort and attractiveness. Easily adjusted, perspiration proof. Insulated semi or half tubing is another appearance improver and will outlast life of the temple. Tubing will not come off and it can't be discolored by dirt or grease. Both the temple and endpiece screws are AO patented "Ever-tite" construction . . . they keep tight in service yet remove quickly when replacing lenses.

IMPROVED GUARD ARMS AND BRIDGE — Guard Arms are newly shaped — longer with more opening for added ease of adjustment. The bridge is double braced with four contact joints — a feature found only in AO Ful-Vue spectacle goggles.

NEW SIDE SHIELD CONSTRUCTION — A real time saver . . . new one-piece binder and eyewire construction *eliminates necessity of inserting the screen before inserting lenses!* Replacement of lenses can now be made without any interference with or from the side shield.

For these and many other reasons, be sure to see the new F4100. YOUR NEAREST AO SAFETY REPRESENTATIVE CAN SUPPLY YOU.

American Optical COMPANY
SAFETY PRODUCTS DIVISION

SOUTHBRIDGE, MASSACHUSETTS • BRANCHES IN PRINCIPAL CITIES

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In the long run...

ALLOY STEELS COST LESS!

● It's true! From crown block to drill bit, in the long run and over the long run, Republic Alloy Steels often cost less than less-expensive carbon steels.

The reason? Extra strength . . . extra toughness . . . more uniform response to heat treatment . . . harder working surfaces . . . higher resistance to fatigue. *All* are qualities which enable alloy steels to withstand the gruelling strains and wear encountered in deep drilling operations, with less danger of costly breakdowns.

Republic offers you a 3-Dimension Metallurgical Service. Veteran field metallurgists—working closely with laboratory and mill metallurgical staffs—are ready to give you prompt, helpful assistance in properly applying these cost-cutting steels to your own specific requirements.

Write, wire or phone *today.*

REPUBLIC STEEL CORPORATION
Alloy Steel Division • Massillon, Ohio
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, N.Y.

For years, alloy steels have been proving their money-saving ability in drill bits, tool joints, subs, swivels, kellys, blocks, hooks and draw-works parts. They can do the same for you.

Republic REPUBLIC STEEL ALLOY STEELS

Other Republic Products include Casing—Tubing—Line Pipe—Upson Studs, Bolts, Nuts and Rivets—Electrunite Boiler Tubes

WHERE YOU SEE THIS... YOU SEE

Longer Chain Life, Lower Chain Cost, Easy Adjustment, Faster Service!

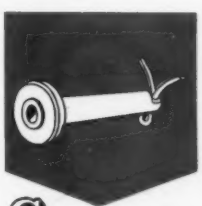
This distinctive "teardrop" shape link marks the new "BA"... Baldwin Assembly . . . oil field roller chain. And it's the mark of long low-cost drilling service.

The new "BA" assembly roller chain gives you all the advantages of riveted roller chain . . . long life . . . greater strength . . . lower cost . . . plus even greater ease of field assembly and disassembly than with old style detachable roller chains.

HERE'S HOW SIMPLE IT IS!

A The single pin connector is the heart of the "BA" assembly and is readily identified by its "teardrop" shape. One pin in this link has a cotter on one end; the other end is spun over a washer. The other pin is fully riveted to the adjacent link, thus assuring the assembly of the superior life of riveted chain.

B To take the chain apart, simply remove the cotter on the single pin connector link and drive out the pin. Pin is a slip fit through the chain except for a milled flat on the cottered end which is fitted into a special hole in the connector plate. There is no danger of destroying fits or damaging parts with this chain.



C The single pin connector of the "BA" assembly fits snugly into place . . . even though it is a slip fit through virtually the entire link. The washer spun over one end of the pin and the milled flat on the cottered end that is fitted into the special hole in the connector plate, plus the cotter, hold the pin firmly in place.

D An important advantage to you is the fact that the other end of the single pin connector link is firmly riveted to the adjacent link. When the single pin connector is removed, this riveted pin holds the chain parts together, preventing plates from falling out and greatly simplifying assembly.

For all the facts on the "BA" assembly, Rex A.P.I. Chains and Rex Oil Field Pumps, see your local supply store or write Chain Belt Company, 1619 W. Bruce Street, Milwaukee 4, Wis.

BALDWIN·REX

ROLLER CHAINS

a complete line from ¼-inch to 2½-inch pitch

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REX COMPANY

A.P.I. CHAINS

Stay on the Job...Longest!

These famous rotary drilling chains . . . *the chains that have grown up with the oil fields* . . . are built especially for oil field needs. Their ability to take the stresses and strains of tough drilling is the result of such outstanding features as:

BALANCED DESIGN, an important Rex advantage that balances the strength of the chain parts for increased efficiency . . . longer life . . . lighter weight.

MAXIMUM WEAR RESISTANCE, effected by carefully hardened and finished pins, bushings and rollers. All are made from solid stock alloy steel. Pins and rollers are of heat treated, high carbon alloy steel. Bushings are of alloy steel, case hardened for wear resistance.

FORCE FIT ASSEMBLY. Chain parts are carefully machine-assembled to form the famous Rex Unit-Link. Each link is exactly alike . . . each is put together to stay . . . to retain its strength and uniformity under the toughest of drilling conditions.

EFFECTIVE LUBRICATION that prolongs chain life. Oil holes in the bushings put oil where it is needed.

EASY TO TAKE APART. Rex 3-diameter pin makes assembly and dis-assembly easy. No need for heavy driving or the use of drift pins.

Rex Champion Chabel
A. P. I. No. 3. Ultimate
strength 75,000 pound

Rex Champion Chabel
A. P. I. No. 4. Ultimate
strength 170,000 poun

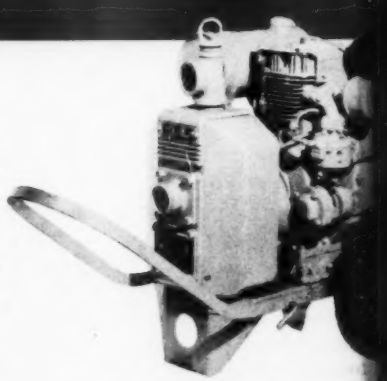
Rex D3125 A. P. I.
No. 3½. Ultimate
strength 230,000 poun

CHAIN BELT REX COMPANY

THE IDEAL PUMP OF OIL FIELD UTILITY SERVICE

The handy Rex "little yellow pump" is used wherever water is pumped. Its lightweight, durable pressed steel body assures easy portability from job to job. Exclusive "adjustable air peeler" and replaceable wearing plate assure new pump efficiency for lifetime of the pump. The peeler permits the pump to handle vapors without losing its prime.

For dependable utility service, rely on Rex, the "little yellow pump." You just start the motor and forget the pump. It keeps right on going while there's water to pump.



Rex Oil Field Sales Offices Are Located in the Following Cities:
NEW YORK • TULSA • DALLAS • HOUSTON • MIDLAND • LOS ANGELES

CHAIN BELT COMPANY

BALDWIN-DUCKWORTH DIVISION
Springfield 2, Mass.

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Milwaukee 4, Wis.

REX CONSTRUCTION MACHINERY DIVISION
Milwaukee 4, Wis.

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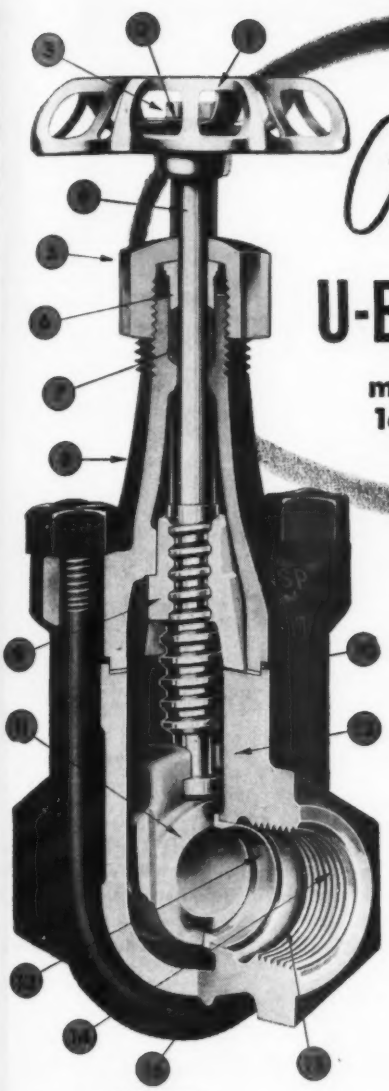
Only Jenkins U-BOLT GATES

measure up to this 16-point standard

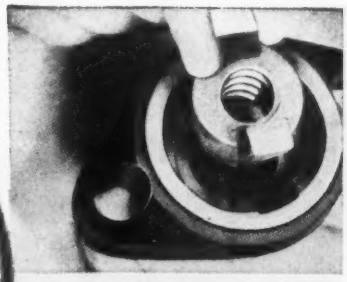


1. Perfect-Grip Handwheel
2. Valve Index Plate
3. Secure Wheel Nut
4. Heavy Manganese Bronze Spindle
5. Large Packing Nut
6. Self-centering Packing Gland
7. Deep Stuffing Box
8. Heavy Duty Bonnet
9. Unique Renewable Bonnet-Saver Bushing
10. Body-Bonnet Safety Joint
11. Extra-Wide Gauge Reversible Bronze Wedge
12. Heavy-Duty Body
13. Bronze Seat Rings, Expanded in
14. Full Length Pipe Threads
15. Liberal Diaphragm Clearance
16. Strong U-Bolt

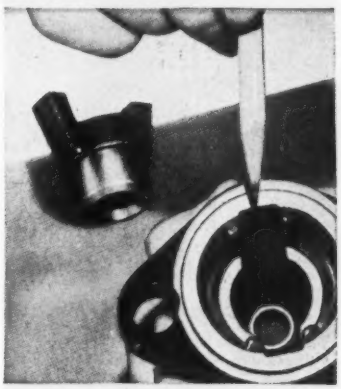
PRESSURES

Screwed	Flanged
150 lbs. Steam	125 lbs. Steam
225 lbs. O.W.G.	175 lbs. O.W.G.

Bronze Mounted or All Iron—Sizes ¼" to 3"



BONNET SAVER BUSHING — No need to junk the bonnet when operating threads are worn. Just slip in a new, patented "Bonnet-Saver Bushing" and have good-as-new thread engagement.



EASY TO CLEAN — You can really get into the bonnet of this valve to clean out the chamber above the operating threads.

RUGGED CONSTRUCTION — Here's proof. When the U-bolt nut was tightened down with a 14" socket wrench until the high tensile steel bolt broke, the heavy duty body and bonnet did not crack!

TROUBLE IS RULED OUT! Check these 16 advanced features—for wear-resistance . . . for ease of maintenance. From handwheel to diaphragm, notice how thoroughly trouble has been ruled out in designing this U-bolt valve. No other valve in its class measures up to Jenkins U-bolt Gate on all these points, many of them exclusive.

You can take it apart and put it together again in two minutes, and it's a cinch to clean. When operating threads become worn, just slip in a new "Bonnet Saver Bushing" and restore it to new-valve efficiency. It's a favorite for those plumbing-heating, mine, mill or any services where excessive sediment is tough on valves and where freezing is a hazard.

For "renewability" without waste, bull-necked endurance, and low upkeep cost, you can't beat Jenkins U-bolt Valves. Yet they cost no more! Full details and specifications in new circular, Form 179-B. Jenkins Bros., 100 Park Avenue, New York 17. Jenkins Bros. Ltd., Montreal.

Sold through leading Industrial Distributors

JENKINS VALVES

LOOK FOR THE DIAMOND MARK

SINCE 1864 — TRADE JENKINS MARK

Jenkins Bros

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ALLIS-CHALMERS

Design Simplicity

Another Big Reason Why HD-5 Leads In Tractor Output

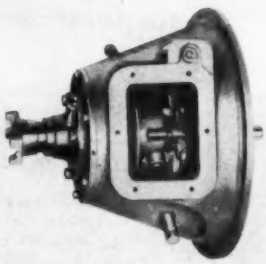
Simple unit assembly is another important reason why the HD-5 is low in total down time required for servicing and maintenance — why it is tops in output per day, per month, per season.

When maintenance is necessary, each assembly is readily accessible for attention. The HD-5 is designed so that each major unit may be easily removed and repaired or replaced *right on the job* without removing unrelated parts. The time and labor saved means substantial increases in the HD-5's over-all output. Remember — a tractor makes money for an owner only when it's working.

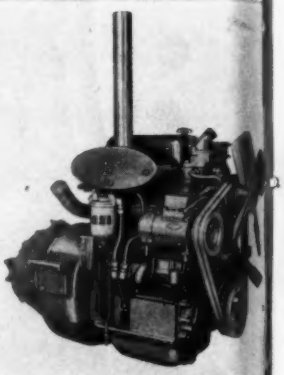
Get the full time-saving service story on the more simply designed HD-5 from your Allis-Chalmers dealer . . . NOW! Ask him, too, for a practical demonstration . . . a demonstration under your own operating conditions. "Seeing Is Believing."

Each steering clutch can be removed independently and without removing final drive pinion or bevel gear.

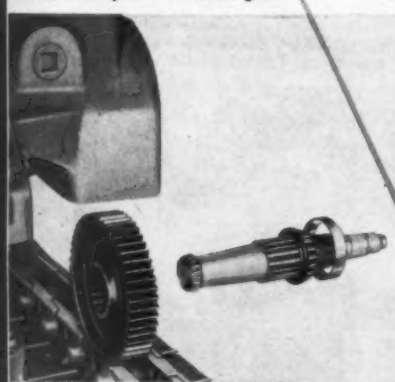
Transmission can be removed as a complete unit without removing clutch, final drive or bevel gear.



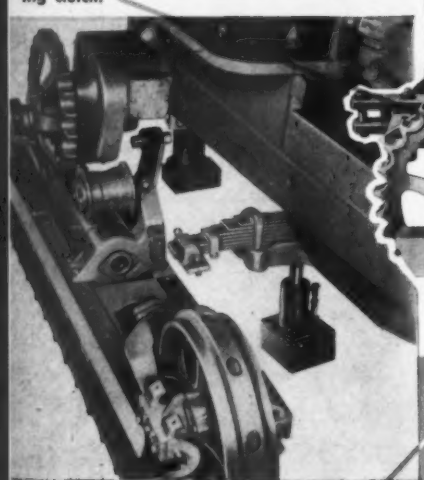
Clutch assembly can be removed without disturbing engine or transmission.



Engine can be removed without disassembling clutch.



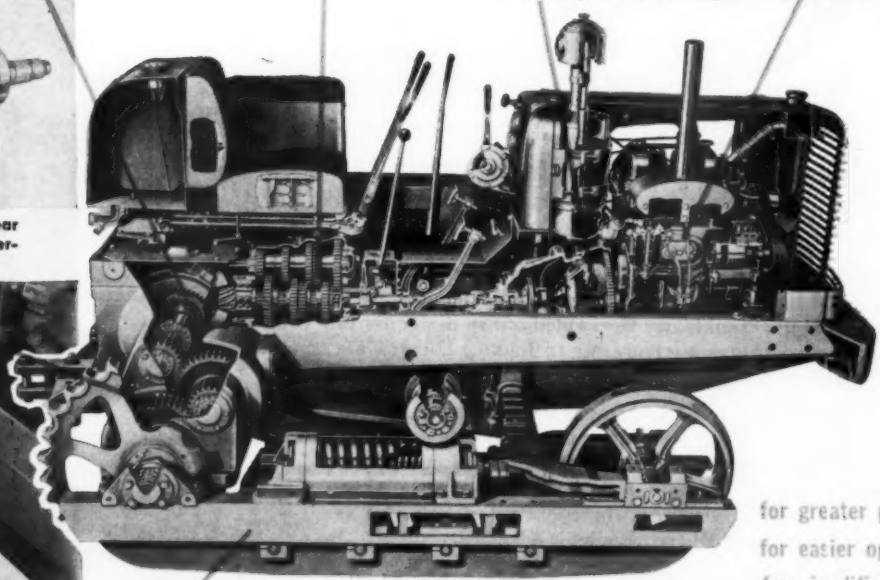
Final drive gear and intermediate gear can be removed without disturbing steering clutch.



Truck frame can be dismantled without removing final drive, sprocket or equalizer spring.

MORE REASONS FOR HD-5 TOP PERFORMANCE

- ★ Exclusive Positive Seal 1,000-Hour Lubrication of truck wheels, track idlers and support rollers
- ★ 11,000 lb. of Balanced Weight
- ★ Greater Operator Comfort
- ★ 2-Cycle Diesel Engine — 40.26 drawbar hp.



for greater productio
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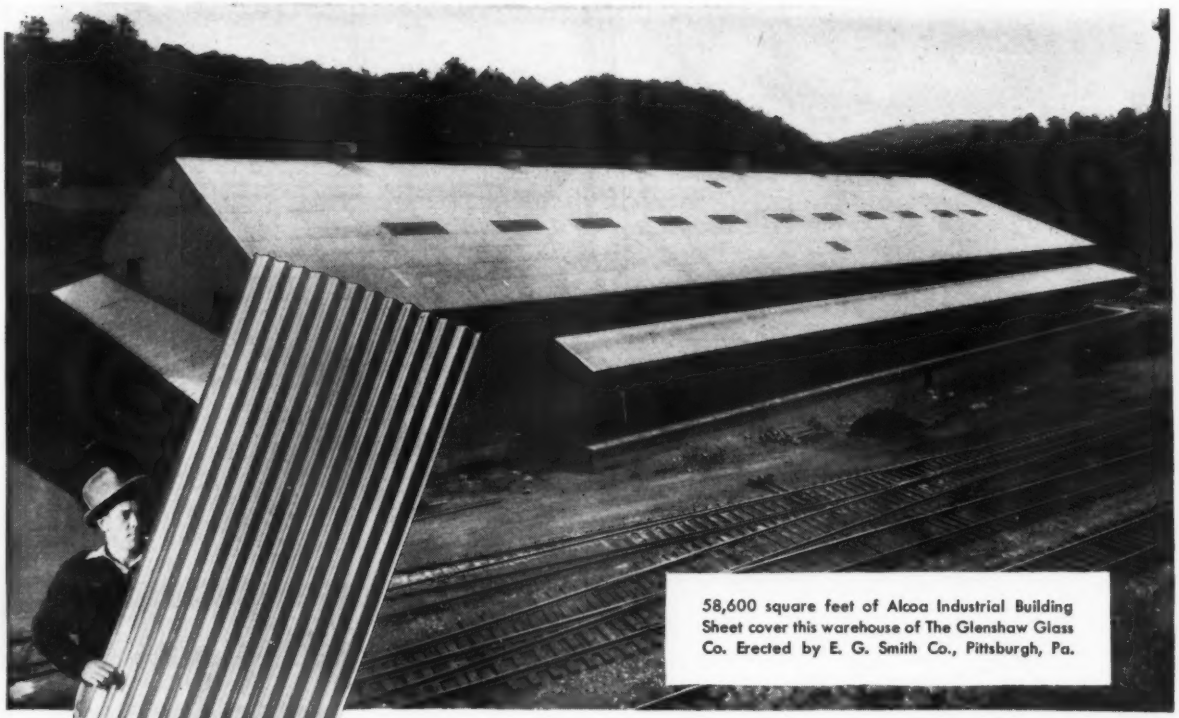
ALLIS-CHALMERS

TRACTOR DIVISION • MILWAUKEE 1, U. S. A.



58,600 square feet of Alcoa Industrial Building Sheet cover this warehouse of The Glenshaw Glass Co. Erected by E. G. Smith Co., Pittsburgh, Pa.

IT WENT UP *FAST!* IT'S BUILT TO *LAST!*

. . . IT'S ALUMINUM!

Covered with big, easy-to-handle units of Alcoa Industrial Building Sheet, this building went up fast, was ready for use as soon as the last fastener was installed. It needs no painting now . . . or ever. Skylights of translucent plastic with matching corrugations went in with the roofing . . . no frames, no extra glazing required.

If you want speed, if you want freedom from maintenance, if you want corrosion resistance and lasting economy, figure your next building in Alcoa Industrial Building Sheet. For price and engineering data, call your nearby Alcoa Sales office or mail the coupon.

FACTS FOR CONTRACTORS AND ENGINEERS

Alcoa Industrial Building Sheet may be erected over steel or wood; may be fastened by nails, purlin nails, straps, clips, screws or weldable studs.

Lengths: 5 to 12 feet. Widths: Roofing, 35 inches. Siding, 33⅓ inches.

Thickness: .032 inches—equal to 22 U. S. Gauge.

Available for prompt shipment with flat and preformed flashing; all types of fasteners.

For complete details MAIL THIS COUPON, TODAY

Aluminum Company of America
1468K Gulf Bldg., Pittsburgh 19, Pa.

Please send me complete engineering and application data on Alcoa Industrial Building Sheet.

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Company _____

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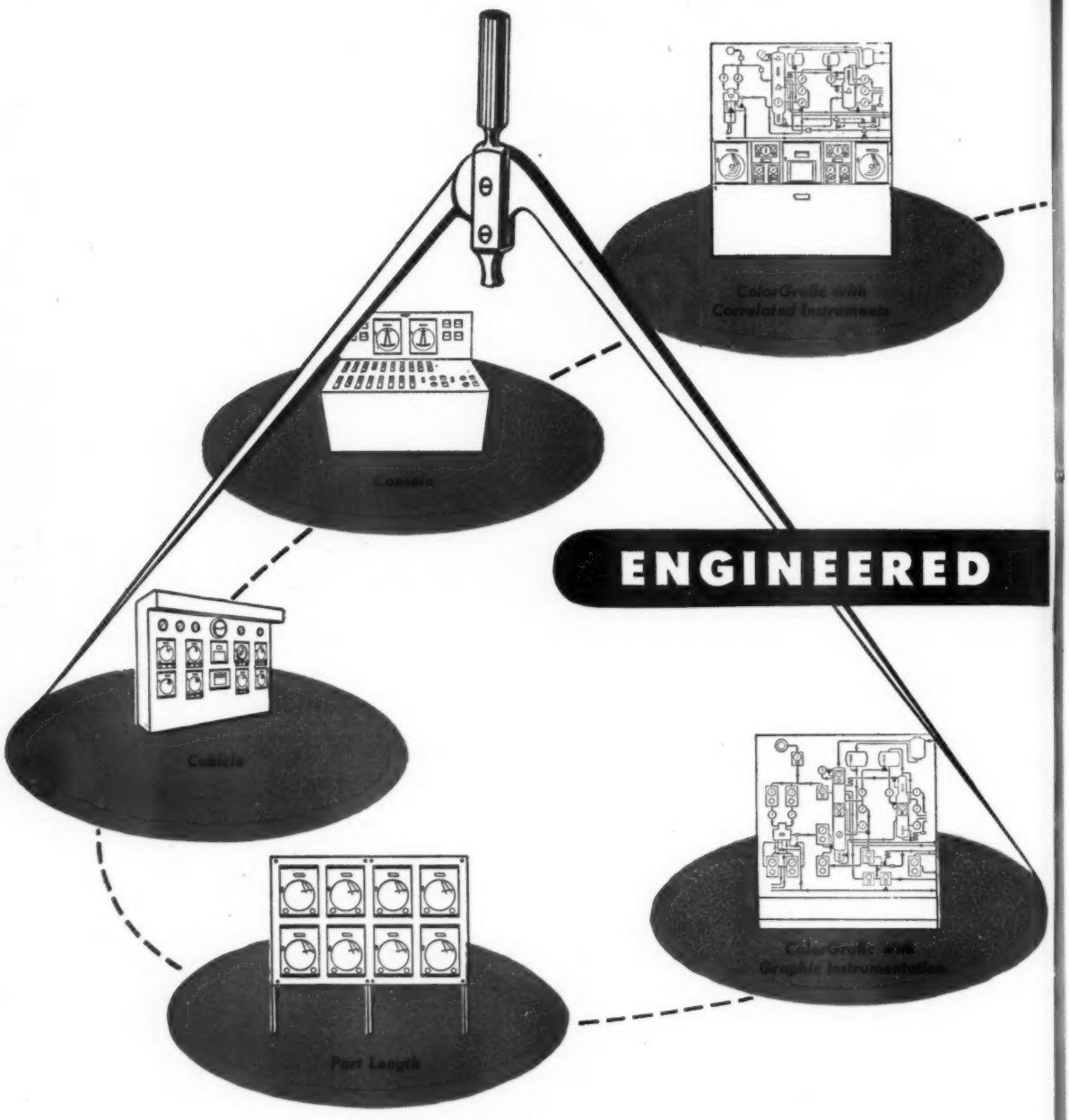
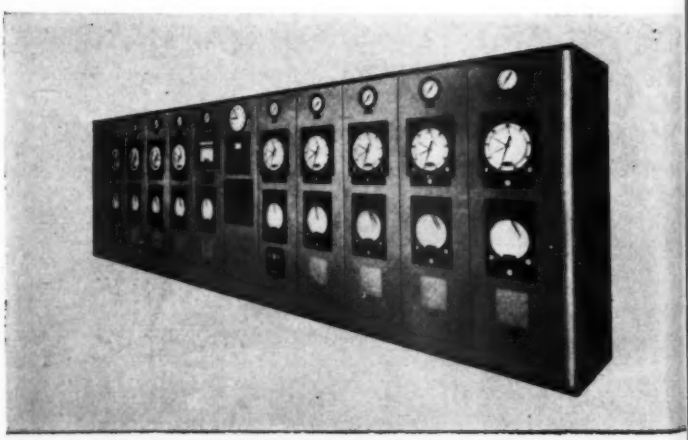
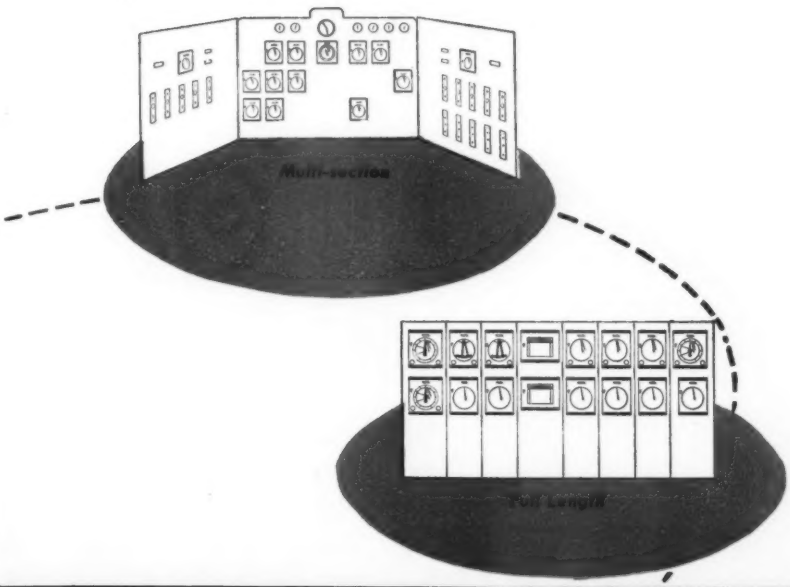
ALCOA INDUSTRIAL BUILDING SHEET

ALCOA ALUMINUM ®



This unit illustrates one of the variety of types of Packaged Panels now available to industry . . . engineered and assembled by a corps of panel design specialists to fit the specifications of the simple as well as the complex processes.





AND PACKAGED TO SUIT YOUR SPECIFIC REQUIREMENTS!

A BROWN *PRE-WIRED AND PRE-PIPED INSTRUMENT PANEL* AFFORDS THESE OUTSTANDING ADVANTAGES . . .

A Relieves you of costly details involved in obtaining panel materials, accessories and fittings . . . and preparing wiring and piping diagrams and layouts.

B Simplifies installation . . . you receive a complete unit, fitted to your process, requiring only a minimum of connections.

C Simplifies maintenance . . . orderly arrangement of instruments and components permits easy access for checking and service.

D Adds new efficiency and convenience to process operation by planned grouping of instruments for finger-tip control and at-a-glance checking.

A PRE-WIRED and pre-piped instrument panel can be designed and produced to your specifications in any one of the seven basic types illustrated!

Your local Honeywell engineer is qualified to discuss the details of your process requirements and to recommend the type of Packaged Panel best suited to your operations. Call him in today . . . he is as near as your phone!

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4488 Wayne Ave., Philadelphia 44, Pa. Offices in more than 80 principal cities of the United States, Canada and throughout the world.

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

XUM

CP tool joints

dependably uniform

Because of their precision manufacture you can always rely on CP Tool Joints for unvarying uniformity.

Made from the finest chrome-nickel alloy steel under exacting controls for hardness, every joint must pass rigid inspections and alignment tests. Finally each joint has to meet a water pressure test of two thousand pounds per square inch to make certain that the threading is absolutely accurate and watertight.

CP Tool Joints are available in API Standard, Full Hole and Internal Flush (for External Upset Drill Pipe) types, sizes 2⅜" to 6⅝" inclusive.

CHICAGO PNEUMATIC TOOL COMPANY

MANUFACTURED AT FRANKLIN, PA.

GENERAL & EXPORT OFFICES: 6 EAST 44th STREET, NEW YORK 17, N. Y.

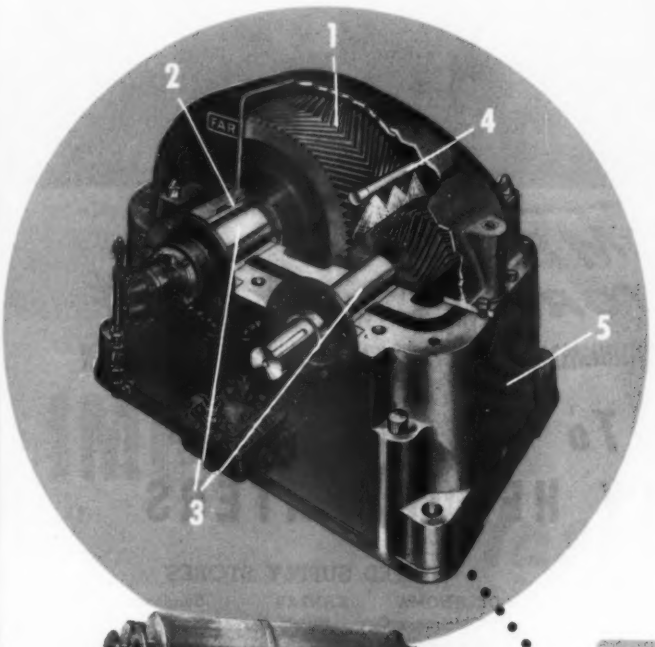
Oil Tool Sales Office: One N. W. 16th Street, Oklahoma City, Oklahoma

In Canada: 10103 Eighty-First Avenue, South Edmonton, Alberta, Canada

HERE'S WHY THIS SPEED INCREASER

practically

"takes care of itself"



If you exercise normal precautions in installing and starting up a Farrel speed increaser, only a minimum of attention is necessary for the unit to practically "take care of itself." Here's why:

1. **PRECISION GEARS** — Precision generation by the famous Farrel-Sykes process, evenly distributed load, overlap or interlacing of the teeth, gradual engagement and inclined line of pressure keep power transmission efficiency "fresh" through long years of service.

2. **OVERSIZE SLEEVE BEARINGS** with consequent low unit pressures. Precision finished to extremely close tolerances.

3. **PRECISION-GROUND SHAFTS** — Extra large for the power to be transmitted. Give added stiffness against bending and torsional deflections under peak loading variations.

4. **A "FOUNTAIN OF YOUTH"** — The completely self-contained circulating oil system virtually puts power on "velvet" by providing a protective spray of oil at the mesh line of the gears and, at the same time, pressure-lubricating the bearings.

5. **EXCEPTIONALLY RIGID HOUSING** holds rotating elements in original alignment, insuring maintenance of operating smoothness of the precision-generated gearing.

For full information about Farrel speed increasers, write for your copy of Bulletin No. 448A. No cost or obligation.

FARREL-BIRMINGHAM COMPANY, INC., ANSONIA, CONN.

Plants: Ansonia and Derby, Conn., Buffalo, N. Y.

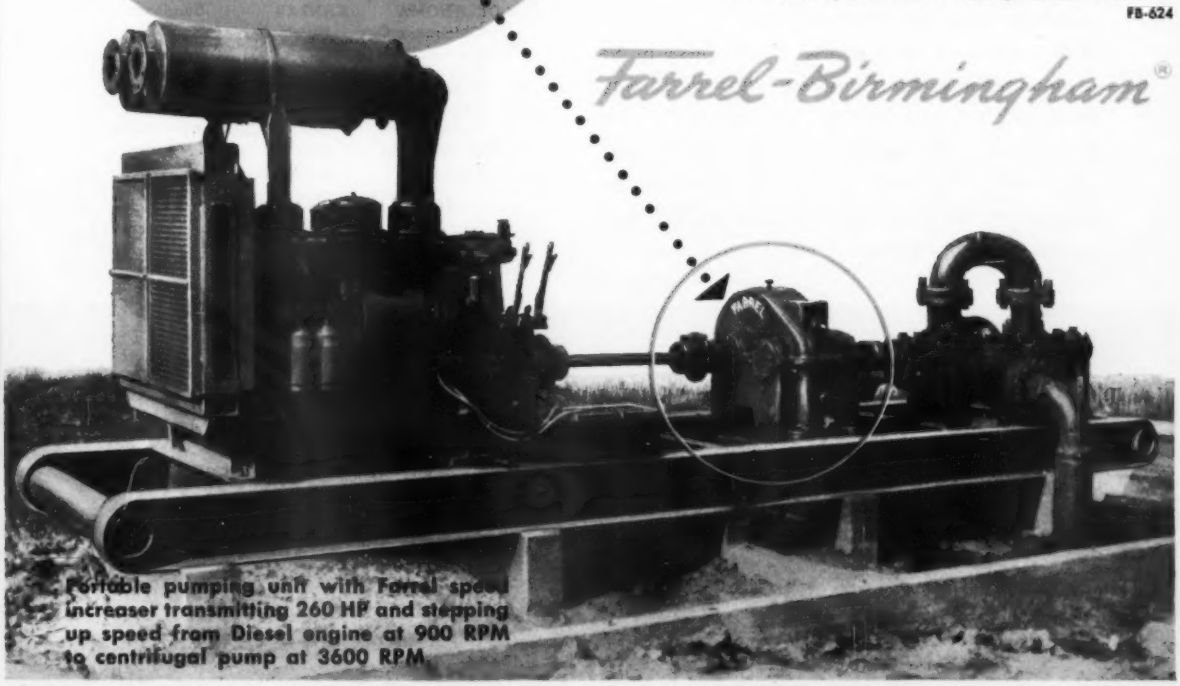
Sales Offices: Ansonia, Buffalo, New York, Boston, Pittsburgh, Akron, Cleveland, Cincinnati, Detroit, Chicago, Los Angeles, New Orleans

OIL FIELD REPRESENTATIVES:

Hercules-Lupfer Engine Sales Co., 124 N. Boston St., Tulsa 1, Okla.
V. W. Osborne, 822-A M & M Building, Houston 2, Texas

FB-624

Farrel-Birmingham®



Portable pumping unit with Farrel speed increaser transmitting 260 HP and stepping up speed from Diesel engine at 900 RPM to centrifugal pump at 3600 RPM.

Uncle Sandy
THE UNITED SUPPLY MAN

Welcome To Tulsa . . .
UNITED SUPPLY HEADQUARTERS

Welcome! All of us at United Supply Headquarters have the Welcome Mat out for you. We want your stay in the Oil Capital to be a pleasant one, so, if we can help you in any way, or, if you'd like to use our offices for phone calls, correspondence, etc., stop in any time. We're located on the 4th floor of the Oklahoma Natural Gas Building at 7th and Boston. Phone 4-5154.

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Courtesy
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UNITED SUPPLY
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Stores in Kansas, Oklahoma, Texas, Louisiana, and New Mexico

IMPERMEX—

Insures Good Mud

Add Impermex, and you insure your drilling mud against troubles that arise from mud contamination. Impermex protects against the flocculating effects of salt, cement, anhydrite, gypsum, and other mud contaminants. Without this protection in the presence of these harmful compounds, ordinary drilling muds lose their solids to endanger the bit, and release damaging amounts of water to the formation.

With either fresh or salt water, Impermex makes any mud a better mud. Hundreds of operators have used it successfully for the following purposes:

1. FOR DRILLING THROUGH CAVING FORMATIONS or those that ordinarily become dispersed in the mud stream when customary drilling muds are used.
2. FOR CONTINUED USE OF THE SAME MUD after penetrating a flow of salt—or otherwise contaminated water.
3. FOR DRILLING THROUGH PRODUCTIVE ZONES with minimum loss of fluid to the formation.
4. FOR OBTAINING REPRESENTATIVE CORES and drill stem tests.
5. FOR UTILIZING SEA WATER or other salt water sources for drilling fluid.
6. FOR MEETING ROUTINE DRILLING PROBLEMS that require low-water-loss mud for their solution.

Baroid

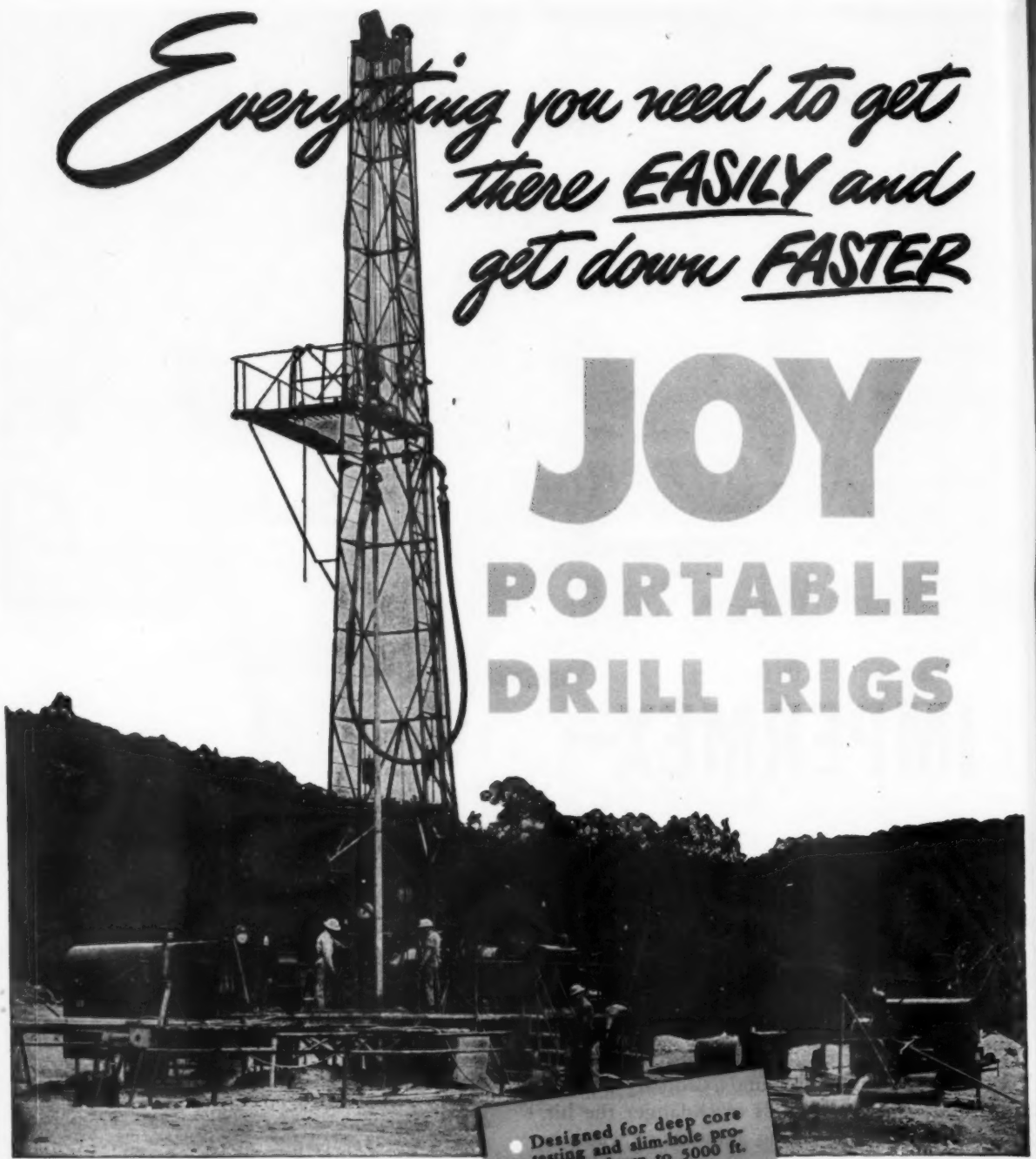
BAROID SALES DIVISION
NATIONAL LEAD COMPANY
LOS ANGELES 12 · TULSA 3 · HOUSTON 2

Complete Drilling Mud Service

XUM

Everything you need to get there EASILY and get down FASTER

JOY
PORTABLE DRILL RIGS



- Designed for deep core testing and slim-hole production down to 5000 ft.
- Compact and highly portable.
- Ruggedly built for heavy-duty field service.
- Other JOY Drill Rigs for any need.

Reduce your costs with the No. 300 MOTORIZED DRILL RIG, illustrated

W&D O 2053 WRITE FOR BULLETIN

Consult a Joy Engineer

JOY MANUFACTURING COMPANY

GENERAL OFFICES: HENRY W. OLIVER BUILDING · PITTSBURGH 22, PA.

IN CANADA: JOY MANUFACTURING COMPANY (CANADA) LIMITED, GALT, ONTARIO

It's New!...but so much more than just New

To control and maintain processes at ideal flow, temperature, or pressure, the new 150# Hancock Bronze Flocontrol Valve is the most efficient and economical valve you can use.

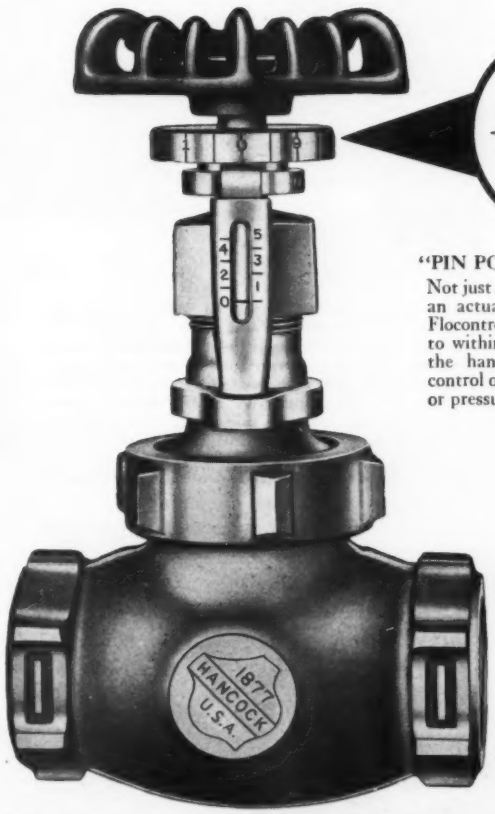
Though it is a fine, strong, leak-defying valve, *it is also a precision control instrument.* The Hancock Flocontrol has a sturdy micrometer dial and pointer securely attached to the valve bonnet. This device enables the operator to "set" the valve at the ideal opening—within a 1/100th turn of the handwheel. And this precise setting can be exactly and instantly duplicated the next day, week, or month.

The scientifically designed V-Port disc *compels proportional flow throughout the entire lift of the valve stem.* Straight-line flow is not dependent upon the short-wearing, fine threads of a needle valve. The Hancock Flocontrol Valve has long-wearing standard Acme threads.

The shut-off seating surface is entirely separate from the controlling V-Ports. Wire drawing and cutting action are minimized; a separate shut-off valve is not needed.

Seats and discs are "500 Brinell" stainless steel. Foreign matter or steam cutting cannot affect their mirror-like finish.

Hancock Flocontrol Valves reduce production costs. They eliminate guesswork in the control of flow, temperature, or pressure.



"PIN POINT CONTROL"
Not just a "catch phrase" but an actuality. The Hancock Flocontrol Valve can be "set" to within a 1/100th turn of the handwheel for precise control of flow, temperature, or pressure.

OTHER HANCOCK FLOCONTROL VALVES FOR HIGHER TEMPERATURES AND PRESSURES

BRONZE FLOCONTROL, 300# W.S.P., 550° F.
Globe & Angle—Screwed Ends—Sizes ½" thru 2"
STEEL FLOCONTROL, 600# W.S.P., 850° F.
Globe & Angle—Screwed & Socket Weld Ends
Outside Screw & Yoke—Sizes ¼" thru 2"
STEEL FLOCONTROL, 600# W.S.P., 800° F.
Globe & Angle—Flanged Ends
Outside Screw & Yoke—Sizes ½" thru 2"

CAST STEEL FLOCONTROL—Screwed Bonnet—300# W.S.P., 800° F.
Outside Screw & Yoke—Screwed & Flanged Ends—Sizes 2½" & 3"
CAST STEEL FLOCONTROL—Bolted Bonnet—300# and 600# W.S.P., 800° F.
Outside Screw & Yoke—Flanged Ends—Sizes 2½" thru 4"

Contact your nearest Hancock Distributor for complete information

MANNING MAXWELL & MOORE INC. TRADE MARK

HANCOCK *Valves*

1877 HANCOCK U.S.A.

A PRODUCT OF

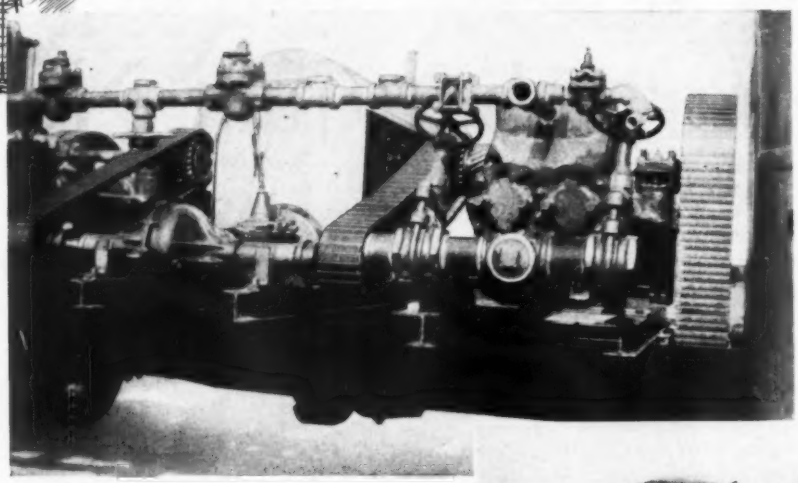
MANNING, MAXWELL & MOORE, INC.

WATERTOWN 72, MASSACHUSETTS

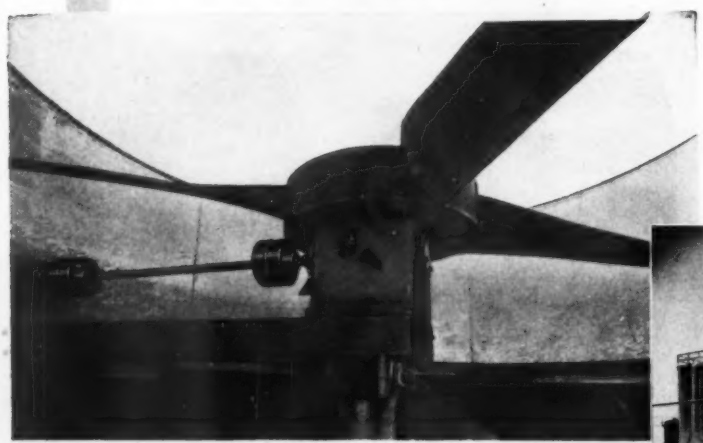
Makers of 'Hancock' Valves, 'Ashcroft' Gauges, 'Consolidated' Safety and Relief Valves, 'American' Industrial and 'Microsen' Electrical Instruments. Builders of 'Shaw-Box' Cranes, 'Budgit' and 'Load-Lifter' Hoists and other lifting specialties.

XUM

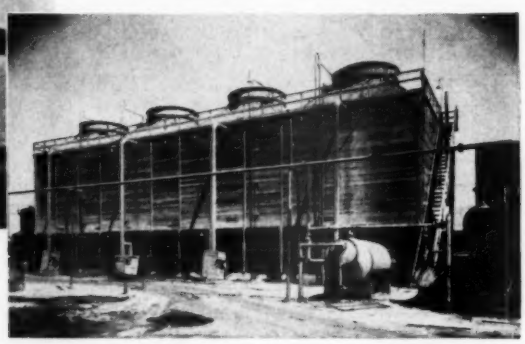
Here's down-to-earth



The two high-pressure pumps on this oil well cementing rig, used by Drilling and Exploration Co., were gasoline-engine-operated. Power from the engines, mounted on the truck bed, was transmitted through a Morse Coupling to a right-angle, double-extended-shaft gear box; thence by Morse Silent Chain Drives to the respective pump drive shafts. Another Morse drive transmitted power from the split-power take-off on the truck drive shaft as a source of emergency power for the pumps in case the pump engines failed. Units of this type are still in use after years of service without a chain replacement.



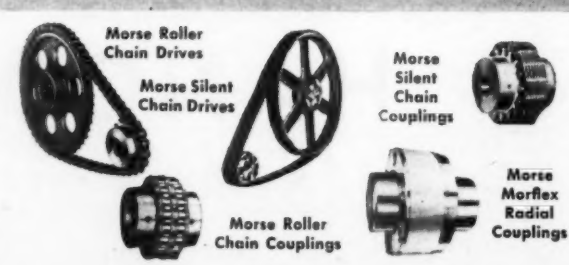
The giant, 12-foot fans in these cooling towers at Champlin Refining Company have operated in hot moisture vapors 24 hours a day, month after month, for over four years. The 30-h.p., 1800-r.p.m. motors are connected to right-angle vertical reducers by 5-foot Morflex Drive Shafts. Fan speed is 500 r.p.m. Two Morse Morflex 802 Couplings are used on each drive shaft for each fan in each tower. Other couplings, previously used, required lubrication and maintenance. The Morflex Drive Shafts have required no maintenance at all.



Ask the Morse Man for power transmission information!

100 Morse Branch Offices and Distributors to supply your power transmission demands.

From coast to coast there are more than 100 offices, representatives and distributors of Morse Power Transmission products to give you quick information and service when you want it—where you want it. *Ask the Morse Man first in any case!* Check your classified phone directory under **"Power Transmission"** or **"Chains"** for the nearest Morse Man.


Morse Roller Chain Drives
Morse Silent Chain Drives
Morse Silent Chain Couplings
Morse Roller Chain Couplings
Morse Morflex Radial Couplings

proof of MORSE durability . . . 2 EXAMPLES OF RUGGED OIL-FIELD SERVICE

When it comes to durability required for tough oil-field jobs, Morse Power Transmission equipment can't be beat, as these two applications prove.

Morse Silent Chain Drives, shown in the upper picture, worked for over 10 years transmitting power for operating the pumps on an oil well cementing rig, taking loads varying from light to heavy shock without a whimper.

Morse Morflex Couplings on the drive shafts of giant fans used on a refining company's cooling towers, pictured below, have been at work continuously for over four years. Despite heat and excessive moisture, they have required no attention.

Morse Products Have Durability Built In

All Morse Power Transmission equipment—whether it be silent chain or roller chain drives, sprockets or couplings — is built to "take it" throughout long years of hard service.

Why not talk over your power transmission problems with your nearest Morse Man. No matter how specialized or complex your needs may be, he can show you how the basic formula M = PT – Morse *means* Power Transmission – can pay off for you.

M=PT
BASIC FORMULA

Morse *means* Power Transmission

Morse Morflex Couplings

Morse-Rockford Clutches

Morse Morflex Drive Shafts

Morse-Rockford Pullmore Clutches

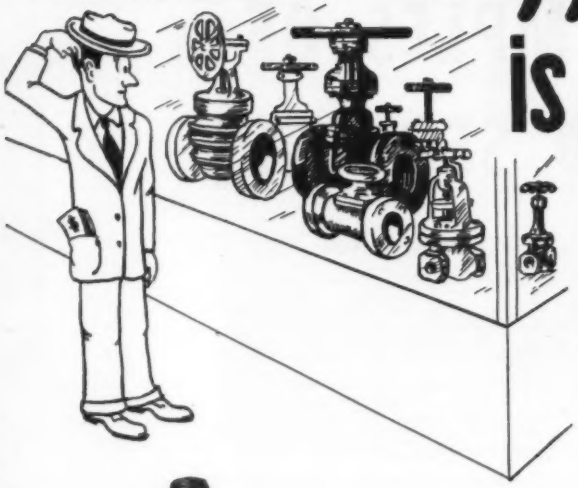
MORSE
MECHANICAL POWER TRANSMISSION PRODUCTS

PRODUCTS OF B-W BORG-WARNER

MORSE CHAIN COMPANY, Dept. 573
7601 Central Ave., Detroit 8, Michigan

XUM

"Window Shopping" for Valves is poor economy



Reading advertisements is like "window shopping"—it's a good way to see what's on the market. But don't let it influence you into buying your flow control equipment from different sources.

Because if you buy all your valves from one source you avoid these pitfalls:

Complications in stocking spare valve parts.

Difficulties that confront the maintenance department in making repairs on a variety of valves.

The necessity of carrying a much larger stock of repair parts.

The chances of installing valves that are not backed by adequate engineering service.

By offering the *only* COMPLETE line of valves available to Industry today, Powell makes this possible. And if you consult Powell Engineers and select the right valve to suit each individual service, your flow control problems are ended.

Fig. 6079 M.O.—Class 600-pound Cast Steel Gate Valve for Pipe Line Service. Has flanged ends and bolted flanged bonnet. Motor operated. Also available in Classes 150, 300, and 400 pounds.

Fig. 375—200-pound Bronze Gate Valve. Screwed ends, union bonnet, inside screw rising stem and renewable "Powellium" wear-resisting nickel-bronze disc.

Fig. 1561—Class 150-pound Cast Steel Swing Check Valve with flanged ends and bolted cap.

Fig. 1793—Large 125-pound Iron Body Bronze Mounted Gate Valve with flanged ends, bolted flanged yoke, outside screw rising stem and tapered solid wedge. Also available in All Iron.

The Complete Powell Line includes Globe, Angle, "Y", Gate, Check, Non-return, Relief and Flush Bottom Tank Valves in Bronze, Iron, Steel and a wide range of Corrosion-resistant metals and alloys.

Ask your nearest Distributor—or write direct

The WM. POWELL Co., 2525 Spring Grove Ave.
P. O. Box 106, Station B, Cincinnati 22, Ohio
DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

POWELL VALVES

For Top Flight Gas Welding

Choose from AIRCO'S complete line of Oxyacetylene Welding Supplies

Time Proved . . . Job Tested . . . Money Saving

Available from Local Stocks

That's right! Whether you use a popular Airco gas welding rod, flux, or brazing alloy for production or maintenance operations . . . you're certain of top-notch work—ask any one of the thousands of welders who swear by these Airco oxyacetylene welding supplies.

This well-recognized reputation for top performance didn't just happen—more than thirty years' experience and development have gone into the manufacture of these outstanding gas welding supplies . . . know-how that produces high quality, reasonably-priced items that guarantee a job done faster, done better, done easier and done at less net cost.

For further information about Airco's oxyacetylene welding supplies which includes a complete line of rods, fluxes and brazing alloys, write your nearest Airco Office or Authorized Dealer for a free copy of Catalog 12.

More news about AIRCO products

AIRCO No. 1 ALLOY STEEL

A Smooth-Flowing, High Ductile Rod Insuring Good Control of Molten Pool

This rod (AWS Classification GA60) is ideal for welding low carbon and low alloy steels, including pipe of grades A and B analysis. Outstanding among its many important features is the high ductility in the "as welded" condition. Because of its mechanical properties, this rod is desirable when undertaking qualification tests like those included in The American Standards Association Code for Pressure Piping. It is smooth flowing, insuring good control of the molten pool, and, in addition, will withstand considerable heating without burning.

PHOS COPPER

A High Standard Copper And Phosphorous Brazing Alloy

It is self-fluxing when used on copper-to-copper joints but requires a good low melting point flux when brazing brass, bronze or other alloys. It is completely fluid at approximately 1382°F. at which temperature best results are secured and is used in the manufacture of electrical, refrigeration and air conditioning equipment. Available in rod and strip form.

AIRCO MARVEL BRAZING FLUX

A High Quality Flux That Remains Molten And Viscous Over A Wide Temperature Range

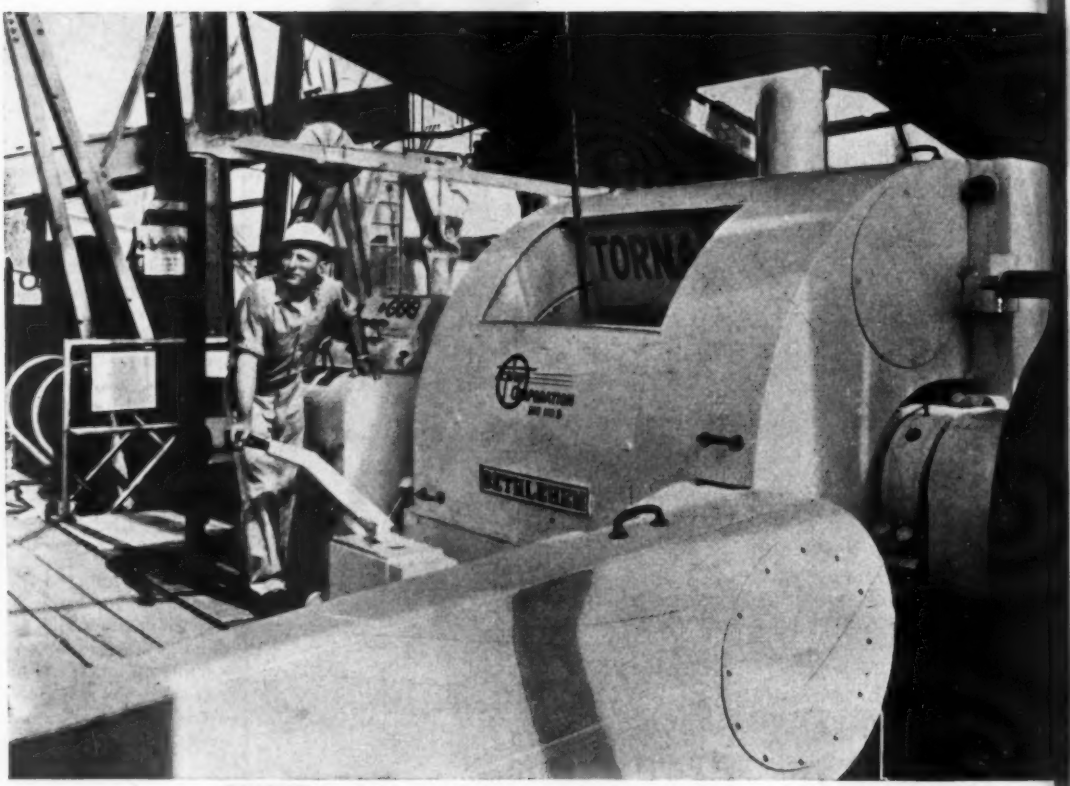
It is a uniformly high-quality flux for use in braze welding cast iron, malleable iron, copper and steel and for welding brass, bronze and copper. Marvel Flux remains molten and viscous over a wide temperature range. Its use protects the weld metal from oxidation and effectively reduces or removes oxides and other foreign matter. Marvel Flux is a general purpose flux for the welding shop.

AIRCO **AIR REDUCTION**

Offices in Principal Cities

XUM

How can a BIG rig be so smooth?



That's a common question among drillers who know the Bethlehem Tornado. It's big, all right; a burly, deep-drilling giant with power to burn. Sturdy isn't the word—it's rock-rugged. Yet it is smoother, easier to handle, than many a smaller unit.

The Bethlehem Tornado has power without complicated mechanisms; power so well controlled that the driller's job is easy. Air controls are part of the answer. But other factors enter, one being the self-adjusting, air-actuated clutches. Another is the air-cushioned transmission, which reduces shocks and jolts to the vanishing point.

Before buying your next deep-hole rig, investigate the Tornado. Study the power, smoothness, and flexibility so skillfully blended in this big outfit. Any time you say, a Bethlehem man will be glad to review its features with you, point by point.

BETHLEHEM SUPPLY COMPANY

General Offices: 21 E. Second Street, Tulsa, Okla.

Subsidiary of Bethlehem Steel Corporation

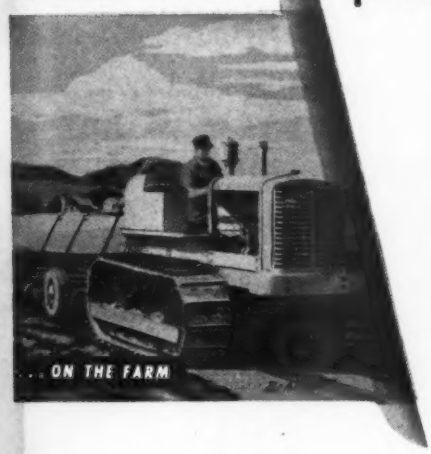
On the Pacific Coast Bethlehem Oil-Field Equipment is sold by Bethlehem Supply Company of California

Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

This is the Diesel

that slashed power costs



COST-WISE power users know there is a big difference in Diesel engines. They've learned from experience that the GM 2-cycle Diesel gives them the full advantages of this versatile modern power.

The GM Series 71 Diesel—the successful engine that powers over 22,250 city and inter-city buses—also powers a rapidly increasing number of heavy-duty trucks. Operators prefer them because the engines perform a million miles or better with spectacular savings in operating and maintenance costs.

It is this same engine, in single and multiple units, that has made Diesel power famous for economy in every type of power application—from giant shovels to road pavers—from tractors to cotton gins—from oil drilling rigs to pipeline pumps—from workboats to pleasure craft—from industrial locomotives to welding sets—from lumbering machinery to standby generators.

This is because GM two-cycle Diesels deliver power on every piston downstroke—not on every second downstroke like most other Diesels. This makes them smoother, more flexible under loads, easier starting, cleaner burning, lighter in weight—and compact enough to fit almost any installation.

Just any Diesel is not the answer—*the* Diesel is the GM Diesel! 299,975 "Series 71's" have provided the best in Diesel power—*Diesel brawn without the bulk.*

DETROIT DIESEL ENGINE DIVISION

SINGLE ENGINES . . . *Up to 275 H. P.* **DETROIT 28, MICHIGAN** MULTIPLE UNITS . . . *Up to 800 H. P.*

GENERAL MOTORS

Hear HENRY J. TAYLOR on the air every Monday evening over the ABC Network, coast to coast

Only GM Diesels provide all these advantages

Smaller size, less weight per horsepower • Two-cycle smoothness, power on every downstroke • Quick starting, on its own fuel • Unit injectors — no high-pressure fuel lines • Rapid acceleration • Cleaner burning • Better high-altitude performance • Easy accessibility

GM
GENERAL MOTORS
DIESEL POWER
"Your Key to Power Economy"

XUM

How to keep a drilling rig from getting off its feed

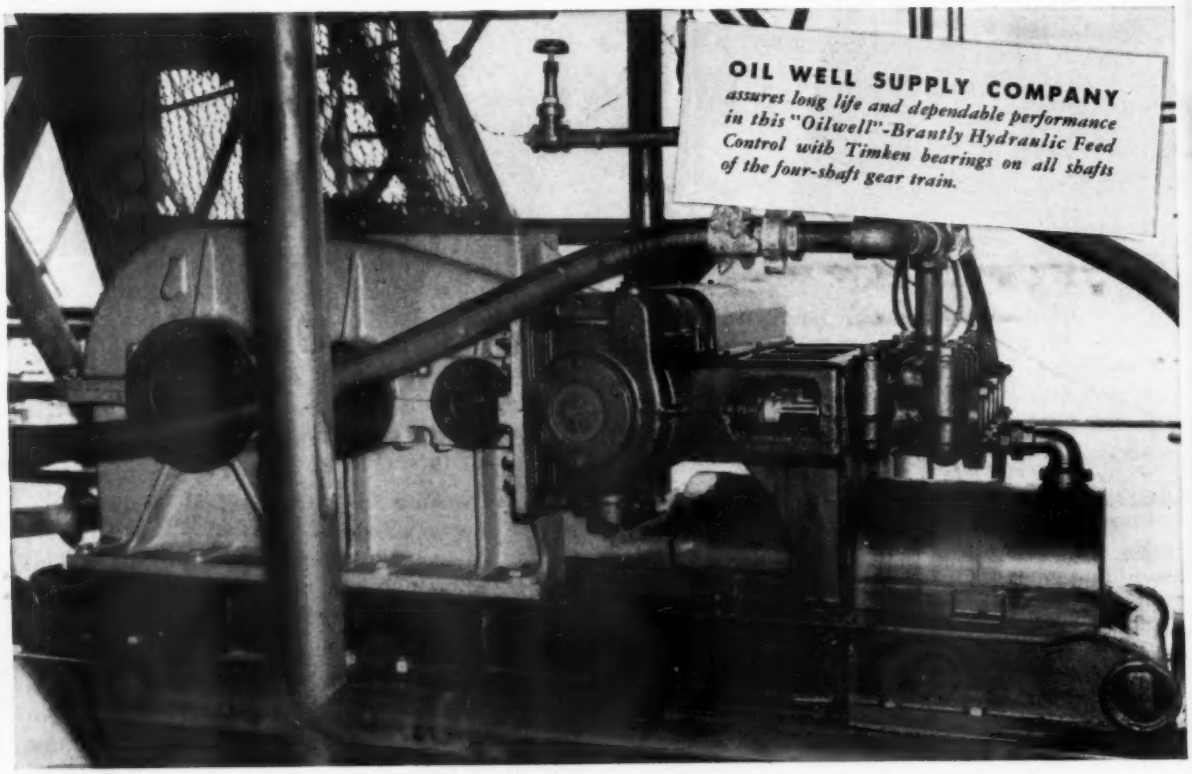
THIS automatically regulated "Oilwell"-Brantly Hydraulic Feed Control maintains uniform weight on the drilling bit to assure maximum cutting life and fewer round trips. This saves valuable drilling time. The four-shaft gear train used in this unit is mounted on Timken® bearings to insure high efficiency and trouble-free performance.

Due to the tapered construction of Timken bearings, both radial and thrust loads are carried in any combination. Under even the heaviest loads, shafts are held in positive alignment. Gears mesh correctly and wear on moving parts is minimized. Line contact between the rollers and races of Timken bearings provides maximum load-carrying capacity. And because Timken bearings are manufactured to extreme limits of precision, friction is practically eliminated.

Timken bearings normally last the life of the machine because they are (1) engineered for the job, (2) made of Timken fine alloy steel, and (3) precision manufactured.

Years of dependable performance have made Timken bearings first choice throughout industry. Whether you buy machinery or build it, always look for the trademark "Timken" on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.


OIL WELL SUPPLY COMPANY
assures long life and dependable performance in this "Oilwell"-Brantly Hydraulic Feed Control with Timken bearings on all shafts of the four-shaft gear train.

FINISHED TO CLOSER TOLERANCES

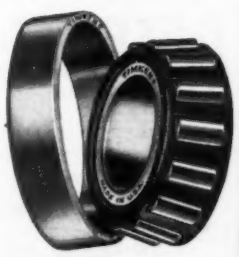
Finishing to incredible smoothness accounts for much of the precise, smooth rolling performance of Timken bearings. This honing operation is typical of the amazingly accurate manufacturing methods at Timken.

The Timken Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ◫ AND THRUST →◫← LOADS OR ANY COMBINATION →✳←

Control* MAKES THE DIFFERENCE

*ONLY PARKERSBURG HIGH PRESSURE EQUIPMENT HAS THE PARKERSBURG NO-BLEED LIQUID LEVEL CONTROLLER

The NEW Parkersburg Hyreco
(High Recovery Unit for gas distillate wells)

Its control that makes a pitcher the outstanding leader in games won. And it's the No-Bleed Liquid Level Controller that makes PARKERSBURG HIGH PRESSURE EQUIPMENT (Hyreco Processing Unit—Horizontal Separators—Hydracepters) leaders in their field.

Hair-Trigger sensitivity of the Controller assures accurate control of the liquid level within an extremely small range. This enables you to maintain the perfect balance between retention time for the fluid and velocity of the gas to obtain maximum liquid-gas separation. The Controller will operate on snap or throttling action with the same precise control.

Unlike ordinary types of level controls, the Parkersburg Liquid Level Controller does not bleed a constant stream of gas which causes plugged holes and freezing to disrupt operation of the equipment. On snap action, gas passes through the controller only when the dump valve is being activated or when the diaphragm case is being evacuated. On throttling control, it permits passage of only a minute volume of gas when the inner valve is adjusting itself.

Get the complete facts about Parkersburg Level Controller and what it is doing to establish higher efficiency in gas-liquid separation. Ask your Parkersburg Representative or write for bulletins.

PARKERSBURG RIG & REEL COMPANY
Parkersburg, West Va.

5015

PARKERSBURG
PRESSURE EQUIPMENT

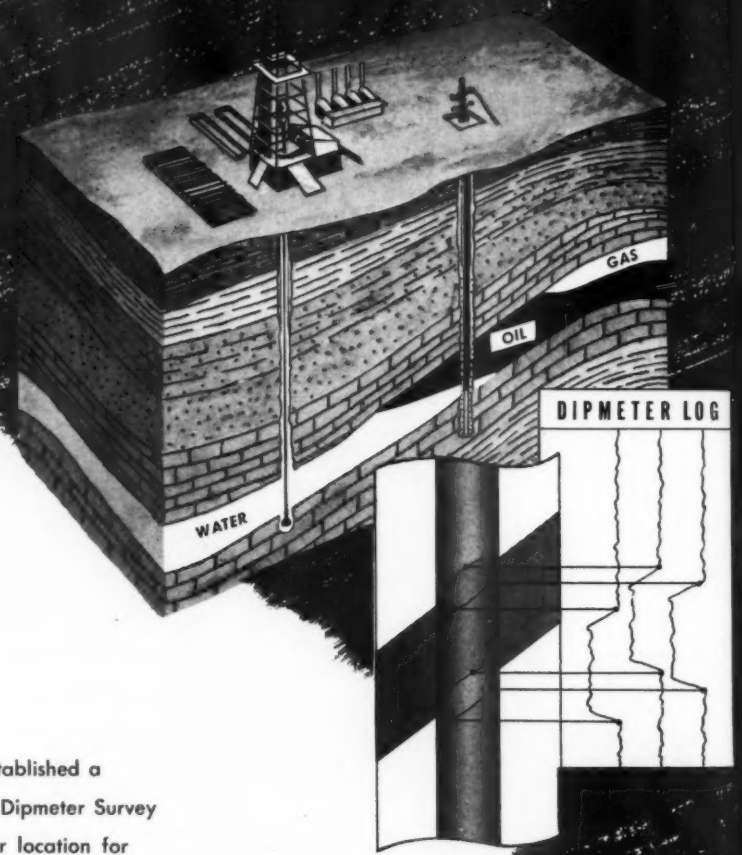
HORIZONTAL AND VERTICAL SEPARATORS • HYRECO • HYDRACEPTER • SCRUBBERS • TREATERS • HEATERS

Manufactured in Houston, Texas

XUM

a

Dipmeter



WOULD HAVE SAVED THE EXPENSE OF DRILLING THIS DRY HOLE

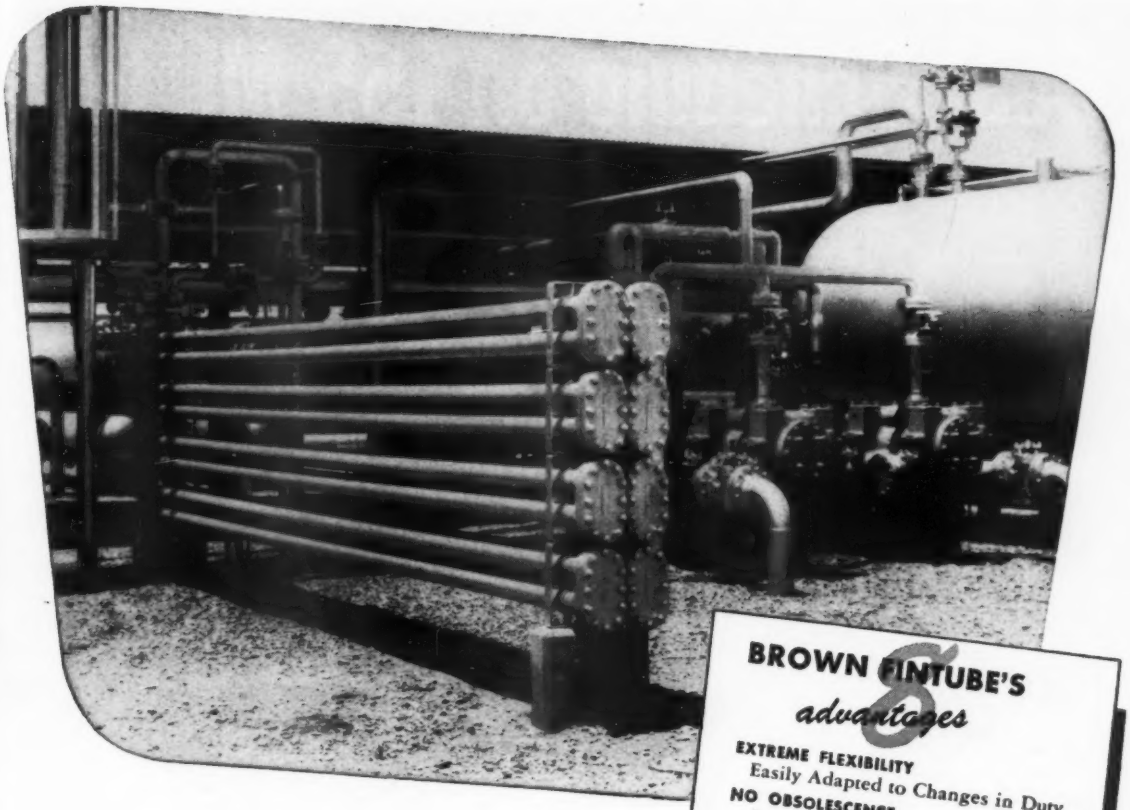
In the illustration, the producing well established a water level in the reservoir. A Schlumberger Dipmeter Survey in this well would have indicated the proper location for the second well. It would have saved the expense of drilling a dry hole.

The Schlumberger Dipmeter has established an excellent record of obtaining dependable measurements of both direction and amount of dip in bore holes. Either resistivity of self potential measurements can be utilized. A Dipmeter Survey can be run in any well drilled under normal conditions, provided the hole is at least six inches in diameter. Ask your Schlumber Engineer for complete details of how a Dipmeter Survey can save you the expense of drilling a

SCHLUMBERGER

The Dipmeter, first introduced by Schlumberger, is a result of Schlumberger's progressive program of research and engineering to provide advanced services to the oil industry.

SCHLUMBERGER WELL SURVEYING CORPORATION • HOUSTON



BROWN FINTUBE'S 6 *advantages*

EXTREME FLEXIBILITY
Easily Adapted to Changes in Duty
NO OBSOLESCENCE
Avoiding Waste and Expense
FLANGED HEAD END ASSEMBLY
Eliminating Ground Joint Seals
EASY MAINTENANCE
Using Only Common Tools
CONTINUOUS OPERATION
No Shut-Downs For Cleaning
REDUCED STORES REQUIREMENT
Minimizing Investment and Handling
QUICK DELIVERY
Only a Few Hours in Emergency
INCREASED CORROSION ALLOWANCE
Longer Tube Life

easy maintenance

Brown Fintube Design Simplifies Inspection and Maintenance

● Brown Fintube Sectional Hairpin Heat Exchangers reduce maintenance three ways:—

1st. BY MINIMIZING COKING. The much increased surface area permits efficient operation at low "skin" temperatures, minimizing coking and building up on the tubes.

2nd. AVOIDING BACK EDDIES. The controlled flow through the longitudinal passages keeps all the material in continuous motion, avoiding baffles, back eddies, and stagnant areas that cause fouling.

3rd. EASY TUBE REPLACEMENT. A fintube hairpin can be taken out of the shell, and a clean hairpin substituted, by only 2 men, in less than 10 minutes, using only ordinary tools and *no special rigging.*

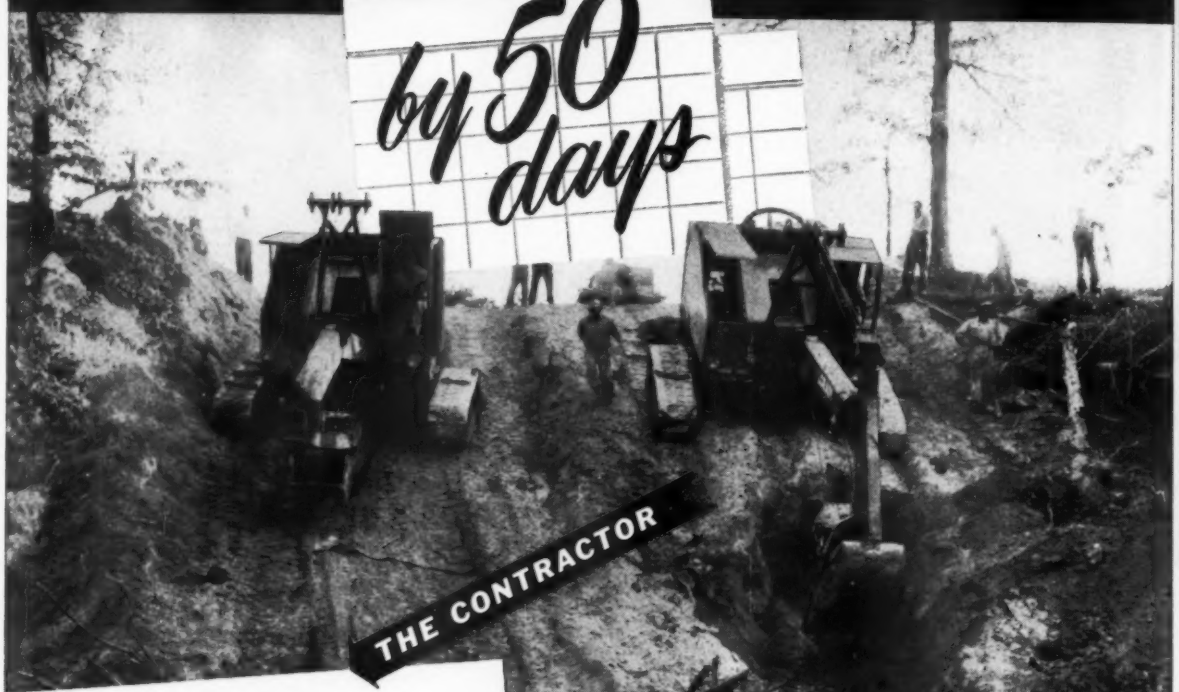
For the utmost in efficiency and economy, use Brown's proven, welded fintube heat exchangers throughout your plant. Estimates and quotations furnished promptly. *Write for Bulletin No. 481.*

THE BROWN FINTUBE CO.
ELYRIA, OHIO

SECTIONAL HAIRPIN HEAT EXCHANGERS

XUM

Beat Schedule on 155 Mi. Job!



THE CONTRACTOR

EASTERN CONTRACTING CO.

This Dallas, Texas pipeline contractor has blazed the way for many a mile of pipe. Their equipment fleet is the most modern for high speed pipelining. Eleven Lorain "Pipeliners" have been selected by this successful contractor to meet the toughest cross-country conditions any machines can encounter. They beat schedules on jobs like this one with the *right machine* for pipeline duty!

THE JOB

1000 MILE TEXAS TO OHIO

It's the big Mid-Valley pipeline job. Two Lorain "Pipeliner Juniors" are shown working between Oakland and Clarksville, Tennessee where Eastern Contracting Co. was building a 155 mile section (in 2 spreads) of 22-inch pipeline. On this rugged section, "Eastern" beat the completion schedule by *50 days!*

THE MACHINES

LORAIN "PIPELINERS"

The *only* machine designed exclusively for pipeline duty with . . . (1) extra-wide crawlers (11 ft. 8 in. or 13 ft.) to straddle ditches as they dig—with plenty of clearance to prevent cave-ins . . . (2) plenty of width to cross *over the ditch* . . . (3) a special "Pipeline" hoe dipper digs clean, vertical walls . . . plus a long list of new, exclusive "built-in" features. Ask your Thew-Lorain Distributor for the "Pipeliner" story for your next job.

THE THEW SHOVEL CO., LORAIN, OHIO

THEW ® LORAIN PIPELINER

THE Armstrong hardened chrome steel valve opens wide and closes tight — with a snap! This eliminates throttling and consequent wire drawing. The Armstrong free-floating lever mechanism is almost frictionless. The bucket and valve lever assembly are 18-8 corrosion resistant stainless steel. The mechanisms of Armstrong steam traps for low and medium pressures are identical in materials and workmanship to those used in Armstrong traps for pressures to 1500 psi, 900 F.

There is nothing in an Armstrong trap to bind, stick, collapse or leak. *Now is the time to quit working for your steam traps and buy the traps that will work for you.* Call your nearby Armstrong representative today.

ARMSTRONG MACHINE WORKS
868 Maple St., Three Rivers, Mich.

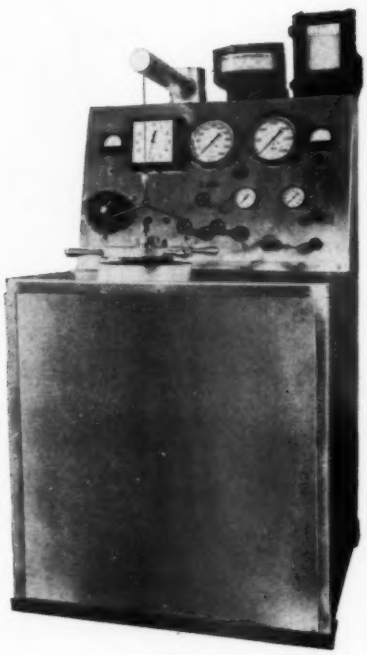
THE 36-PAGE ARMSTRONG STEAM TRAP BOOK contains complete data on the design, operation, selection and installation of Armstrong steam traps for all services. Send for your free copy.

SEE OUR CATALOG IN SWEET'S

ARMSTRONG STEAM TRAPS

R. S. *Super Pressure* Cement

Consistometer



✓ Determine Cement Setting Time
✓ Test Uniformity of Cement
✓ Standardize Your Cement

Provides the complete test equipment for testing cements used in oil or gas wells as outlined in A.P.I. Tentative Code No. 32.

The R. S. Super Pressure Cement Consistometer or Stanolind Thickening Time Tester is used for determining pumping characteristics of oil well cements under bottom hole conditions.

The R. S. Super Pressure Cement Consistometer makes it possible to subject cement to cycles of temperature up to 400° F. and pressures up to 20,000 psi in the laboratory which simulate conditions to be met during actual well cementing operations, and to plot the thickening versus time.

Consult Refinery Supply Co. for *ALL* your laboratory needs.

For Further Information Write for Bulletin No. 50

Refinery Supply Co.
621-23 E. 4th St. Tulsa 3, Oklahoma
Laboratory Apparatus
Instruments Chemicals
MANUFACTURER OF R.S. SPECIALTIES

SAME DRIVE . . . SAME PUNISHMENT

TRIPLE LIFE

ATLAS "BUILT-IN" STAMINA MINIMIZES WEAR AND REPAIR

Trouble-free three times longer . . . one chain outlasting three others! That's the authentic performance of Atlas Roller Chain employed on a chain-eating drive up in New England. Atlas "Super-Life" Chain, with its "built-in stamina," is rolling up thousands of hours of outstanding performance not only on the New England installation but on drives in the Petroleum Industry . . . on pumping units, drilling rigs, diesel engines, trucks, and other types of machinery.

The die-hard stamina of Atlas Roller Chain and its ability to stay on the job is made possible by a special method of heat treating every component part. Bushings and pins are case hardened by the Atlas Nicarb Process which provides an outer surface strongly bound to the core of the steel. Link plates and rollers are also made of tough, heat-treated alloy steel; their uniformity achieved by automatic electronic instruments controlling the furnaces.

To keep present machines running smoothly with fewer unscheduled shutdowns for repairs and replacements, install "Atlas." Specify it for new equipment. There's a stock near you in nearly all types and sizes, ready for immediate delivery. Phone your nearest Atlas distributor or write:

Atlas Chain & Manufacturing Co., Philadelphia 24, Pa.

"SUPER-LIFE"

ATLAS CHAIN

XUM

NOW it's proven!

A PORTABLE-PRACTICAL GEO-LOGGER

THE ELECTRIC WELL-LOGGING UNIT

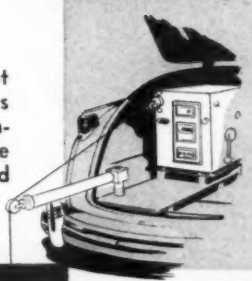
that is

RUGGED, OPERATOR-PROOF, LOW COST, FAST and ACCURATE

GEO-LOGGER

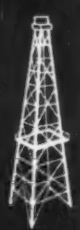
cuts the cost of information out of every shot or core hole of 1500 feet or less. After two years of development and testing, the portable, operator-proof Geo-Logger is ready to save you time and money. OK'd for design, performance and results by geologists and geophysicists who have seen Geo-Logger in operation.

GEO-LOGGER FITS YOUR PASSENGER CAR



No extra vehicle: Geo-Logger is compact, fits inside trunk compartment of any average passenger car, can be mounted on shooting truck or pick-up. Single aluminum case 18" high, 26" long, 14" wide. Powered by extra belt-driven generator, under hood of car or truck, just above regular generator.

SAVE PERSONNEL, TIME, MONEY

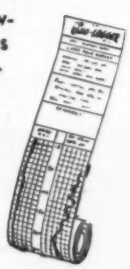


No extra man: Geo-Logger can be set-up and log made by one member of drilling crew. **No extra time:** Geo-Logger gets log of average shot hole (200 feet) in less than 5 min. elapsed time, from start of set-up to out of the hole and out of the crew's way. On a 700-ft. strat test—20 min. elapsed time.

- *EASY TO CARRY*
- *EASY TO USE*
- *EASY TO REPAIR*
- *EASY TO BUY*

ACCURATE, LOW-COST LOGGING COMPARABLE TO SERVICE COMPANY RESULTS!

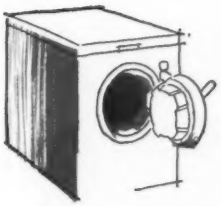
The Geo-Logger gives you electric logs showing resistivity and self potential curves in holes up to 1500 feet; accuracy in every way comparable to service company logs, obtained at a fraction of their cost. Aids in picking proper position for shot, serves the interpreter of seismic records and locates water supplies for operating departments. The Geo-Logger will stretch current logging budgets; will make possible logging that, heretofore, could not be afforded.



NOW AVAILABLE FOR SALE OR LEASE

For further information, write

GEO-LOGGER,
5535 Yale Blvd.,
DALLAS, TEXAS



HIGH SAFETY FACTOR
FOR EXTRA STRENGTH
AND STAMINA

ACCURATE ALIGNMENT
ASSURED BY RIGID,
ONE PIECE MAIN FRAME

MUD-STOP PROTECTION
ABSOLUTELY PREVENTS
CONTAMINATION OF
CRANKCASE OIL

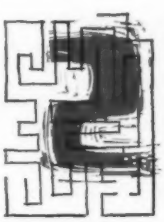
what you need for deeper drilling...

LOW BEARING PRESSURES
RESULT FROM LARGE
DIAMETER ECCENTRIC
CONSTRUCTION

QUIET RUNNING
HERRINGBONE GEARS
ARE SHOCK PROOF
AND EFFICIENT

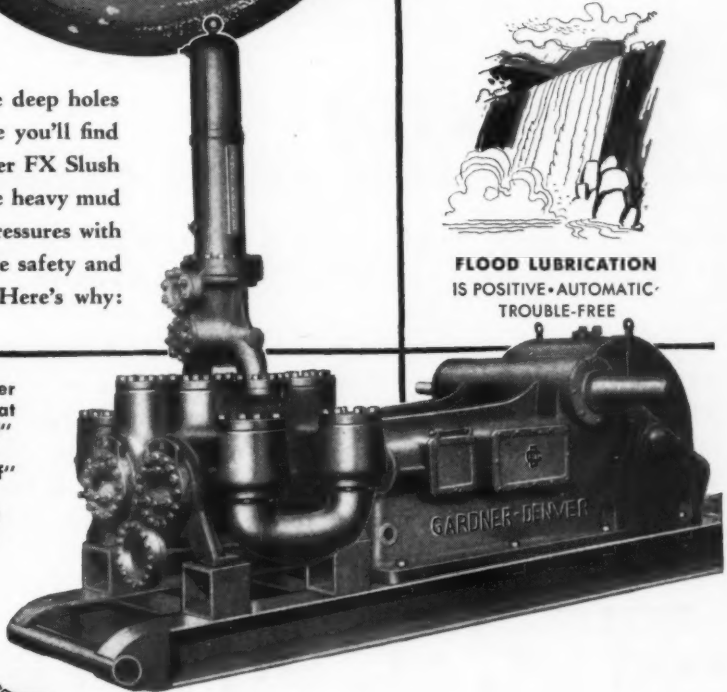
Wherever the deep holes are drilled—there you'll find Gardner-Denver FX Slush Pumps handling the heavy mud and high pressures with complete safety and dependability. Here's why:

FLOOD LUBRICATION
IS POSITIVE • AUTOMATIC •
TROUBLE-FREE



NO HIDDEN BAFFLES
NO MUD-CUTTING
IN DIVIDED CYLINDER LIQUID
END CONSTRUCTION

Plus: **Gardner-Denver "Slush-Proof" Duo-Seat Valves—"Slush-Proof" rods, hardened and ground—"Slush-Proof" pistons—"Superior" liners, hardened and honed—all of which may be changed without opening the crankcase to dust and dirt.**



SINCE 1859

WRITE TODAY FOR FULL INFORMATION

GARDNER-DENVER

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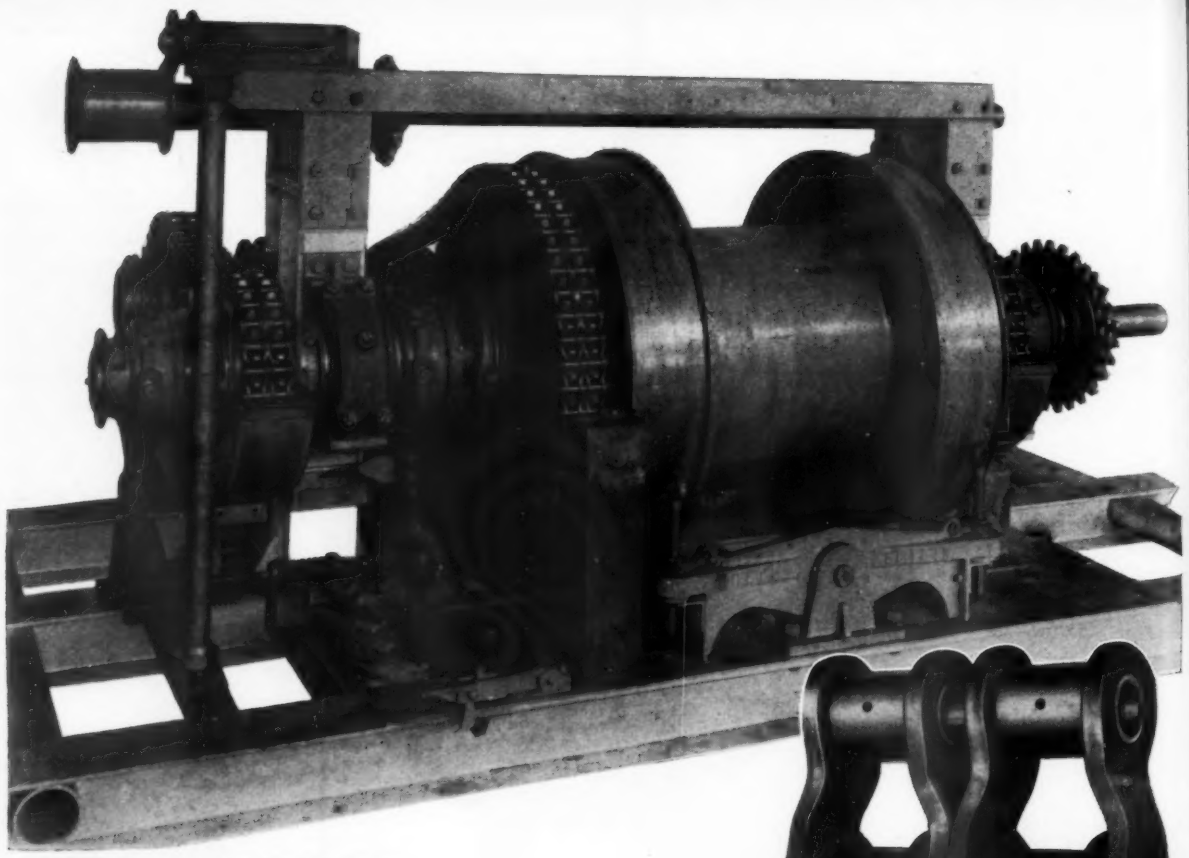
Export Division: 30 Rockefeller Plaza, New York, N. Y.
Republic Supply Co. (of Calif.), 2600 S. Eastland Ave., Los Angeles, Calif.

XUM



HIGH SPEED DRIVE CHAINS

For Driving high speed Portable Rigs, Pumps and similar applications.

General purpose chains made from high grade, properly heat-treated alloy steel. Balanced construction combining short pitch with great strength and light weight. Designed to operate over Manufacturer's Standard machine-cut tooth sprockets. These offset type chains give good sprocket action resulting in longer life for both chain and sprockets. Let us hear from you.

Jeffrey double-strand chain is shown in large view above as well as in close-up. Also furnished in single or triple strands. These chains are made under the same watch-like precision methods that distinguish all Jeffrey Oilwell chains. Catalog No. 708-B goes into detail.

THE JEFFREY MANUFACTURING COMPANY

Established 1877

891 N. Fourth St., Columbus 16, Ohio

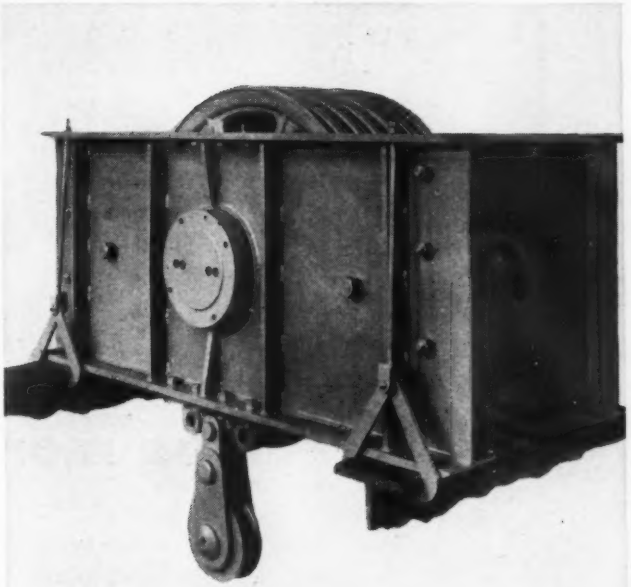
Complete Line of Material Handling, Processing and Mining Equipment

Baltimore 2	Buffalo 2	Denver 2	Jacksonville 2	Pittsburgh 22
Beckley, W. Va.	Chicago 1	Detroit 13	Milwaukee 2	St. Louis 1
Birmingham 3	Cincinnati 2	Harlan, Ky.	New York 7	Salt Lake City 1
Boston 16	Cleveland 15	Houston 2	Philadelphia 3	Scranton 3

Jeffrey Mfg. Co. Ltd., Montreal, Canada
Jeffrey-Galion (Pty.) Ltd., Johannesburg, S.A.
The Ohio Malleable Iron Co., Columbus, Ohio
British Jeffrey-Diamond Ltd., Wakefield, England
The Galion Iron Works & Mfg. Co., Galion, Ohio
The Kilbourne & Jacobs Mfg. Co., Columbus, Ohio

NEW DESIGN

pays off in trouble-free operation



A little over a year ago, Beaumont Iron Works introduced its new Dreadnaught Type KN Crown Block with its companion Dreadnaught Type PN Traveling Block. The completely new ideas embodied in the design of this block combination made such excellent common sense that the Dreadnaught pair was an immediate success. Repeat orders coming in from major customers are the best endorsement of this new design.

NO OTHER CROWN BLOCK HAS ALL THESE FEATURES...

Space Saver—Centerline and narrow centers between sheaves permit block to be hoisted through water table in one piece.

Beam Support—Large diameter center pin mounted in box built into beam *on its center line.* New design provides extremely sturdy and rigid support and reduces over-all height of block.

Two Mountings—As center pin is on center line of beam, *either flange* of beam can be set on water table beams.

Four Positions—By turning block around, deadline sheave can be set in any of *four different positions* to minimize Brinelling effect on races, increasing life of bearings in end sheaves.

Bearing Life—A new idea in bearing design. Row of ball bearings in bronze retainers placed between each sheave. Acts as thrust bearings, resisting both end-wise movement and twisting effect caused by line passing between crown and traveling block.

All-around Protection—Labyrinth type seals between each sheave serve as grease seals and dust guards.

Rated Capacity—360 tons at 100 rpm—600 tons at 10 rpm.

STREAMLINED SPACE-SAVER TRAVELING BLOCK

Extreme Narrow-Width—Streamlined design did the "impossible." Although sheaves and bearings are of larger diameter, and maximum load capacity is built into design, the PN Traveling Block is so narrow and compact it does not restrict pipe racking space on deepest holes.

New Thrust Design—Each sheave mounted on radial roller bearing, separated by row of spherical ball bearings. Adds to bearing life and prevents radial rollers from skewing as *they carry no thrust load on the ends.*

New Strength—Load carried through rolled steel side plates. No spacer plates employed. The becket, capable of carrying load of one line, is buried within block.

Rated Capacity—300 tons at 100 rpm—500 tons at 10 rpm.

EXPECT the Best from BIW—Builders of Proved Drilling and Production Equipment for 40 Years.

WANT TO KNOW MORE?
call or wire ATLAS collect.

BEAUMONT
IRON WORKS COMPANY
Subsidiary, American Locomotive Co.

Exclusive Sales Agents
ATLAS
ENGINEERING WORKS
Houston & Beaumont, Texas

XUM

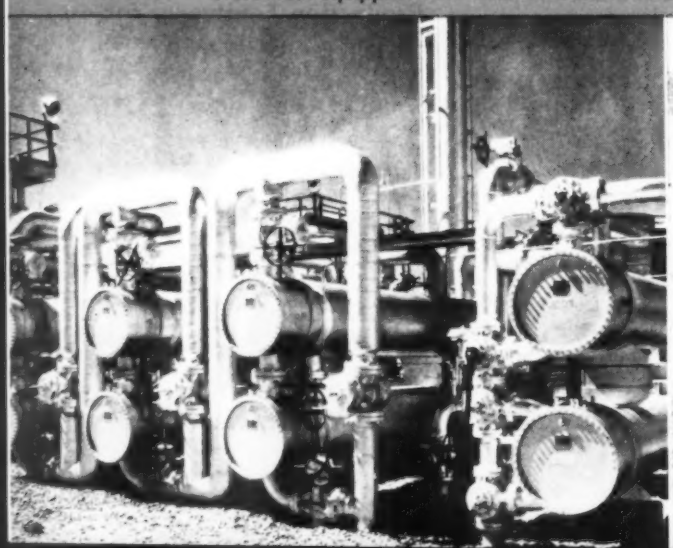
How HEAT EXCHANGER UNITS can be more safely serviced

Heat exchanger batteries are usually in continuous operation with piping arranged so that individual units may be taken out of service for maintenance without interrupting flow through the other units. The success of this operation is dependent on reliable and effective switching valves. If equipped with conventional valves which are vulnerable to leakage or failure, unit maintenance becomes difficult and hazardous or the entire battery may have to be shut down. But, if equipped with Nordstrom valves, individual units can be serviced readily because there's *no leakage, no hazard, no valve failure.* Uninterrupted plant operation, with Nordstroms, can easily save far more than the cost of the valves.

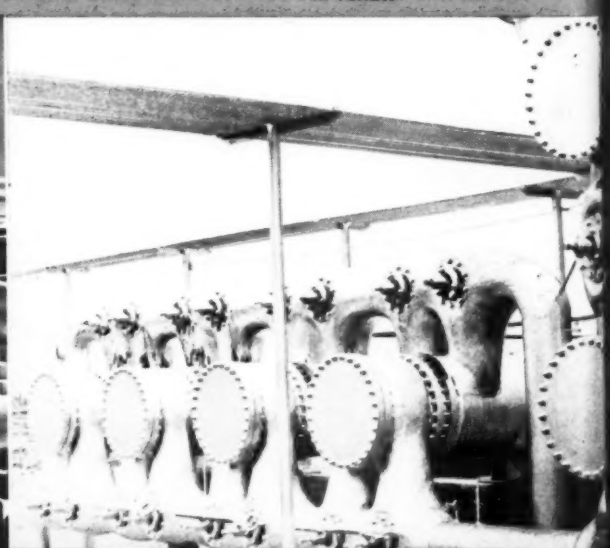
Adopt this habit...

Each time a troublesome heat exchanger valve demands replacement—change to a Nordstrom. Eventually the entire battery will be Nordstrom-equipped. The cost? No more than ordinary valves when you figure the improved service and greatly increased valve life.

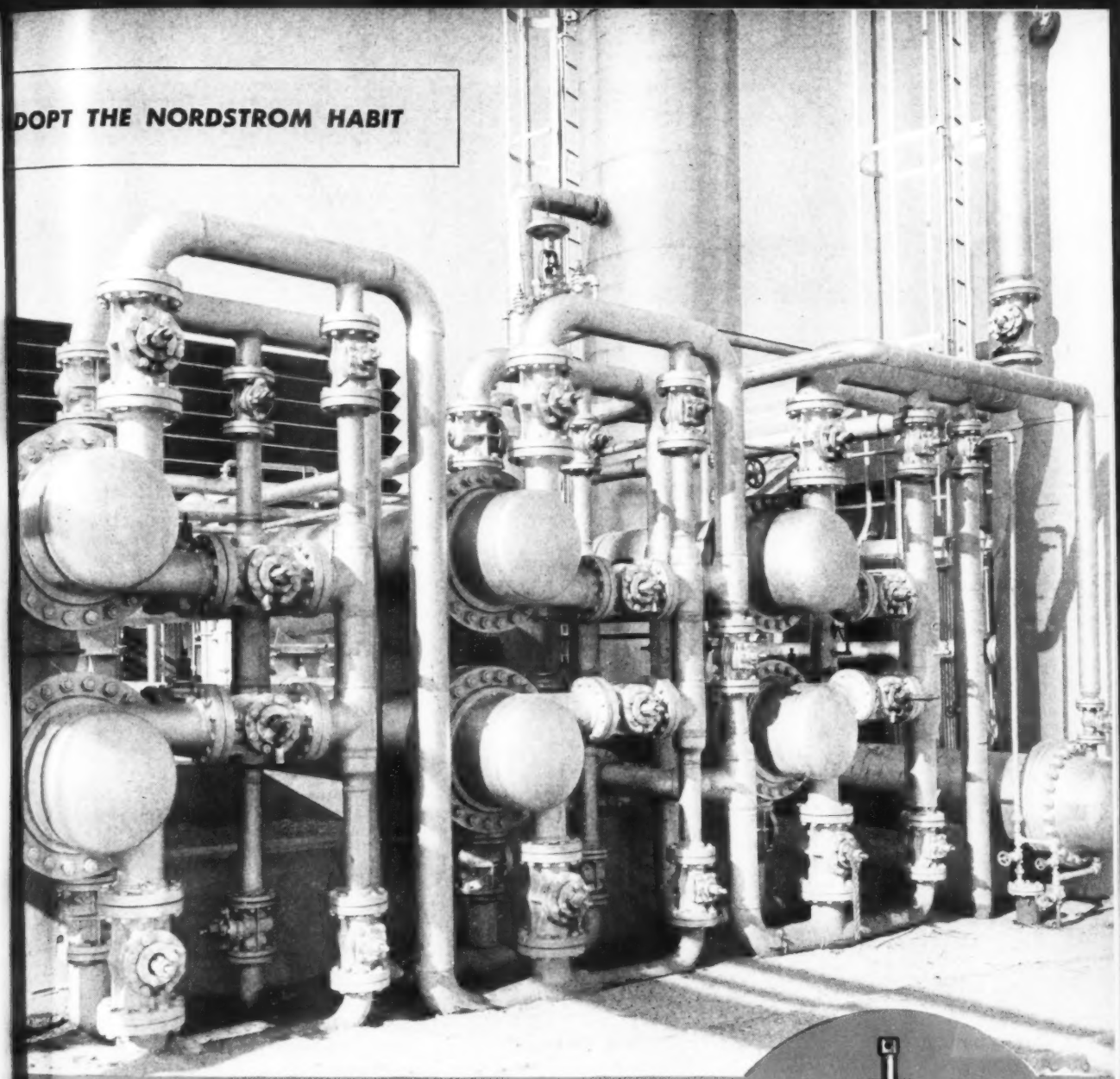
Heat exchangers in a Louisiana refinery, Nordstrom-equipped.



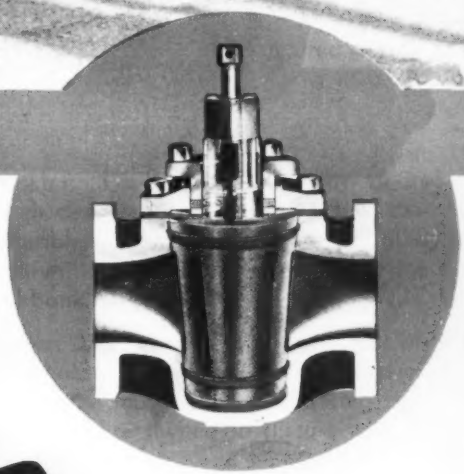
Nordstrom valves on heat exchangers in Texas.



DOPT THE NORDSTROM HABIT



Heat exchanger, Nordstrom-equipped in an Arkansas plant.



Nordstrom LUBRICATED Valves

NOW AUTOMATICALLY LUBRICATED WITH Hypermatic

PATENTS APPLIED FOR

TRADE MARK

ROCKWELL MANUFACTURING CO.

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Export — Rockwell Mfg. Co., International Division, Empire State Building, New York 1

XUM

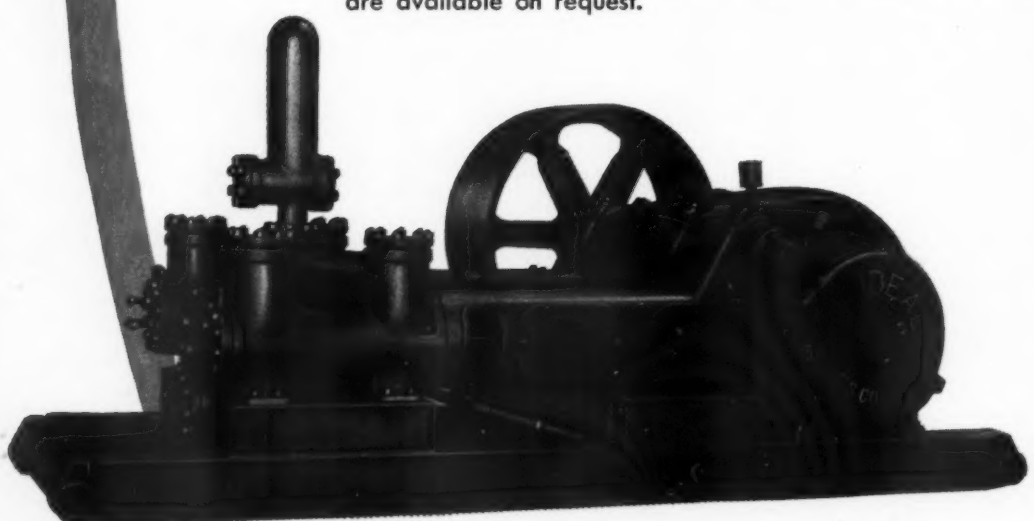
BUILT TOUGH...
FOR A TOUGH JOB

From power end to fluid end, from skids to surge chamber, "Ideal" Slush Pumps are built to give you extra years of trouble-free service at lowest maintenance cost.

The frames of the "Ideal" line are stiffer to assure alignment under heavy load and sudden overload. Crankshaft, gears, rods, and bearings . . . all are extra-large, extra-strong to minimize maintenance.

Design and choice of materials for fluid end parts provide maximum life with a longer time between overhauls. At all points special care is taken to minimize and eliminate mud contamination of lubricants.

Bulletins describing "Ideal" Pumps for all well depths from shallow to deepest, for all types of service from gathering to slush circulation are available on request.



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Dedication to a common cause has created a unity of purpose by which the people of America have built their strong position of economic welfare.

This same kind of strength is equally true of business and banking. It is built on the spirit of its people, on their desire and ability to create a successful, serviceable institution. These are the kind of people you will find ready to serve you at the City National Bank.

The Oil and Gas Division of the City National offers you the services of practical, experienced oil men in planning the most efficient financing program for you. You are invited to discuss your financing with them.

The CITY NATIONAL BANK OF HOUSTON

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

O-C-T C-19 Casing Heads have been used on the World's Deepest...on the World's Highest Pressure Wells

WHY do you suppose the operators of these extreme condition wells both selected the O-C-T "C-19" Casing Head? Under conditions experienced in the world's deepest and the world's highest pressure wells they wanted the best protection money can buy! On wells of all depths and pressures, O-C-T "C-19" performance speaks louder than words. Check and compare these features with any other casing head at any price.

1. Seated through preventers to automatically form a quick, permanent seal between strings before preventers are removed. No manual work required.
2. Seal requires no field welding.
3. Load capacity twice as great as conventional slip hangers.
4. Sealing element, slip bowl and slips are assembled as a single unit.
5. Slips set evenly — slips bit evenly with uniform tooth pressure from top to bottom.
6. Eliminates hazardous work in cramped, muddy cellars.
7. Save valuable rig time.

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They Say—

Sees No Shortage

". . . I believe it is fair to say that the petroleum industry is in splendid shape to take care of the present demands of our armed forces, plus a substantial increase over the next 12 to 18 months, and still have sufficient products to take care of civilian demands.

"The refineries of the nation are running more crude than ever before, and the production of all important products is setting new high records each week. Additional crude is available for further increases if the demand develops. Inventories of gasoline are slightly higher than they were last year. Refinery inventories of burning oils and fuel oil are lower than last year but it is generally believed in the industry that consumer storage is well filled at this time.

"If this is true, we are hopeful that with further increases in the production of burning oils, no serious shortage will be experienced this winter. Those that do occur will probably be of a local nature and of short duration."

R. W. McDowell, president, Mid-Continent Petroleum Corp., Tulsa, writing in the company's house organ, "The Diamond."

Engine Evolution

"Charles F. Kettering was one of the first to comprehend that fuel i as much a component of the auto engine as a crankshaft. The develop ment of tetraethyl lead and the syn thetic fuels which followed from this approach has determined the evolution of our auto engine.

"As a further result, the petroleum industry today does not merely pump oil out of the ground; it is a major and highly advanced unit in our chemical industry. . . . The Kettering high-compression engine promises the reduction by as much as 25 per cent of the fuel cost of our automobile."

Alfred P. Sloan, Jr., chairman of the board, General Motors Corp., writing in "Scientific American."

Tax the Other Fellow

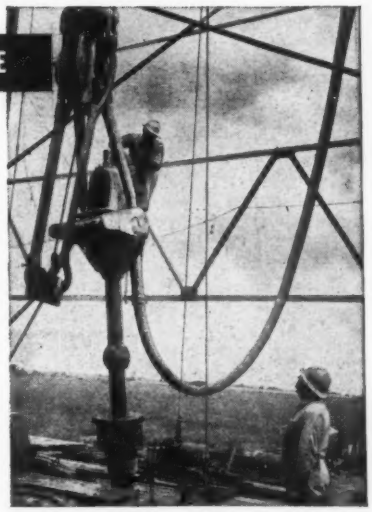
"We are often treated to the sorry spectacle of protests against high general taxes emanating from the very groups which are working ceaselessly to increase the tax burdens of motor vehicle owners.

"If people would only develop a little self-restraint, a little sense of responsibility to others, the agitation for unnecessary increases in gasoline

AT THE DERRICK, THE HOSE YOU DEPEND ON IS

HEWITT-ROBINS

ROTARY DRILLING HOSE



You can't buy better hose for oil well drilling . . . it's made by men who know their job! Hewitt built-in, leak-proof couplings assure an unrestricted, rubber-lined fluidway *all the way;* the high tensile duck carcass is heavily wire-reinforced to withstand extreme pressure, yet the flexibility you want is there; the tough Hewitt cover resists stripping action and abrasion. Whether you choose Monarch for deep well work, Ajax for medium depth drilling, or Conservo for the short holes, you get increased efficiency, lower operating costs, *longer useful hose life.*

MUD PUMP SUCTION HOSE

Best way to cut suction costs is to let Hewitt-Robins help! With Hewitt Mud Pump Suction Hose you prevent hose collapse and kinking because the carcass is reinforced with spiraled spring steel wiring. Built-in, clampless nipples are permanently sealed in the hose—and over everything is a rugged cover that's tougher than all the abuse it will ever get!

ROTARY FLEXIBLE HOSE

Another example of Hewitt-Robins oil-industry specialization. Used between the discharge end of the pump and the end of the standpipe line, Rotary Flexible Hose permits quick relocation of the line without disturbing the pump. It is an excellent vibration dampener and, unlike rigid pipe, it *won't crystallize.*

* * *

For full information on these and many other Hewitt-Robins hoses for the oil industry, call your Hewitt Rubber distributor, listed in the classified telephone directory, or write us.

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HEWITT-ROBINS INCORPORATED

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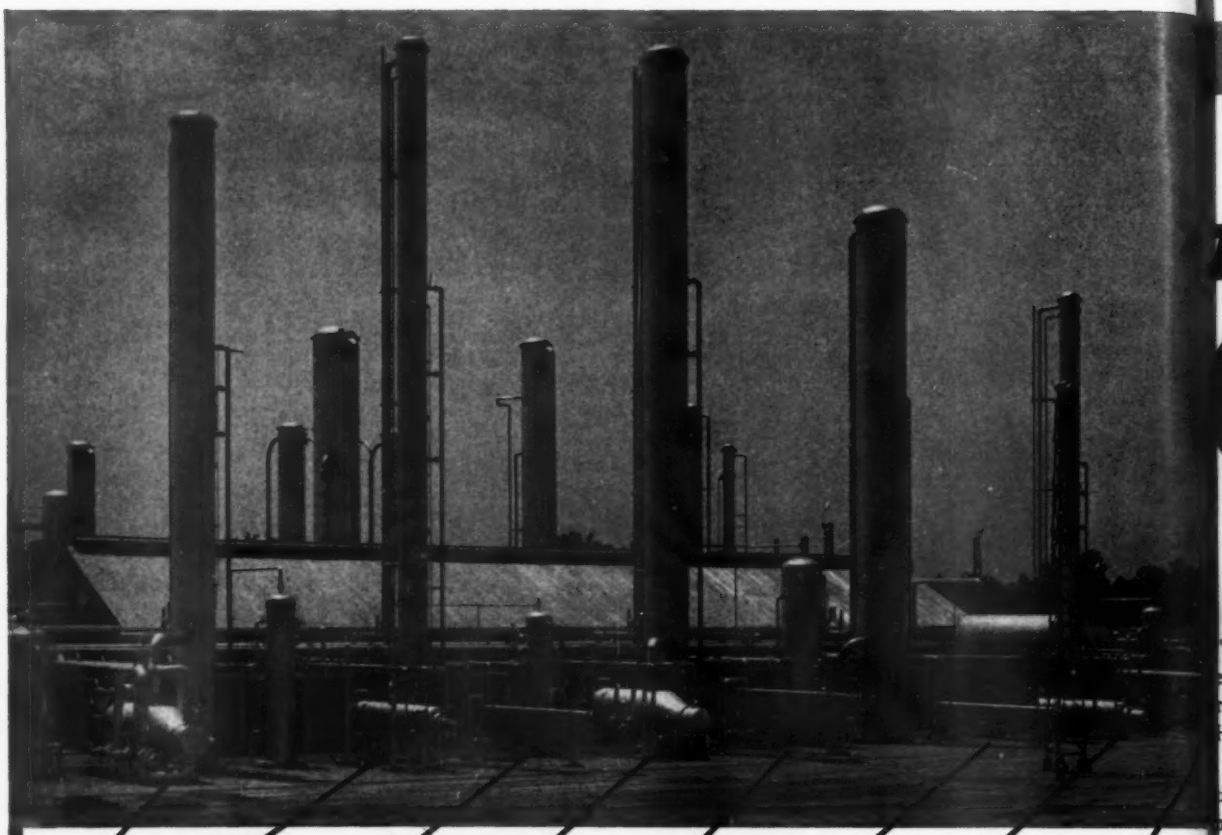


OIL HEATED KEROSENE FRACTIONATOR REBOILER

DE-PROPANIZER REBOILER

TWIN G-FIN DE-PROPANIZER EXCHANGER

DE-BUTANIZER REBOILER

TWIN G-FIN SECTION DE-BUTANIZER BOTTOMS EXCHANGER

TWIN G-FIN SECTION FRACTIONATOR FEED EXCHANGER

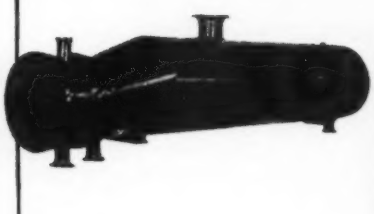
DE-ETHANIZER REBOILER

TWIN G-FIN SECTION BOTTOMS EXCHANG

This portion of a large modern south-western natural gas absorption plant contains the G-R apparatus listed above. The plant also contains 60 G-R Bentube Sections and a large number of G-R Tubular Heat Transfer Apparatus not shown in the illustration.

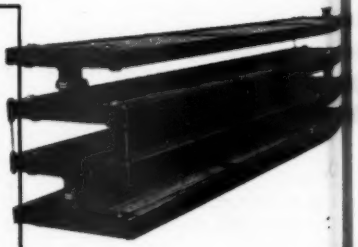
G-R REBOILERS

For producing vapor from liquids heated with steam or hot liquids. The illustrated kettle type has a large vapor space above the tube bundle.



G-R BENTUBE SECTIONS

Patented design of atmospheric or submerged cooling and condensing sections consisting of parallel rows of tubing set with slight initial bow into cast header at each end. Change in temperature causes corresponding change in curvature of the tubes which cracks up and breaks off scale.



G-R TWIN G-FIN SECTION

Standard, interchangeable units of patented hairpin design, consisting of a single G-Fin element, with longitudinal fins within a shell. More than 40,000 of these units are used on practically every heating, cooling or condensing service.

G-R TUBULAR EXCHANGERS

Include many patented features based on 80 years of experience in building heat transfer apparatus. Available in a wide range of types for condensing, heating, cooling or exchanging heat between liquids, gases and vapors.

A good example of G-R "RANGE-ABILITY" at this plant

"RANGE-ABILITY"... the ability to serve efficiently through a wide range of service requirements . . . is a characteristic of G-R Heat Transfer Apparatus.

For example, in G-R Twin G-Fin Sections, this "RANGE-ABILITY" is obtained by simply connecting, in series or parallel, as many of these standard, interchangeable units as required by the duty. The accompanying photograph is a good illustration. This modern natural gas absorption plant uses four banks of G-R Twin G-Fin Sections as follows:

- De-propanizer Exchanger — 3 sections connected in series
- De-butanizer Bottoms Exchanger — 3 banks in parallel, each bank containing 4 sections in series
- Fractionator Feed Exchanger — 2 sections connected in series
- De-ethanizer Bottoms Exchanger — 4 sections connected in series

The same plant uses 60 G-R Bentube Sections (not shown in the illustration) for cooling tower service. These sections are another example of G-R "RANGE-ABILITY" obtained through standard designs, and are operating at pressures ranging from 125 psi to 2750 psi in this plant.

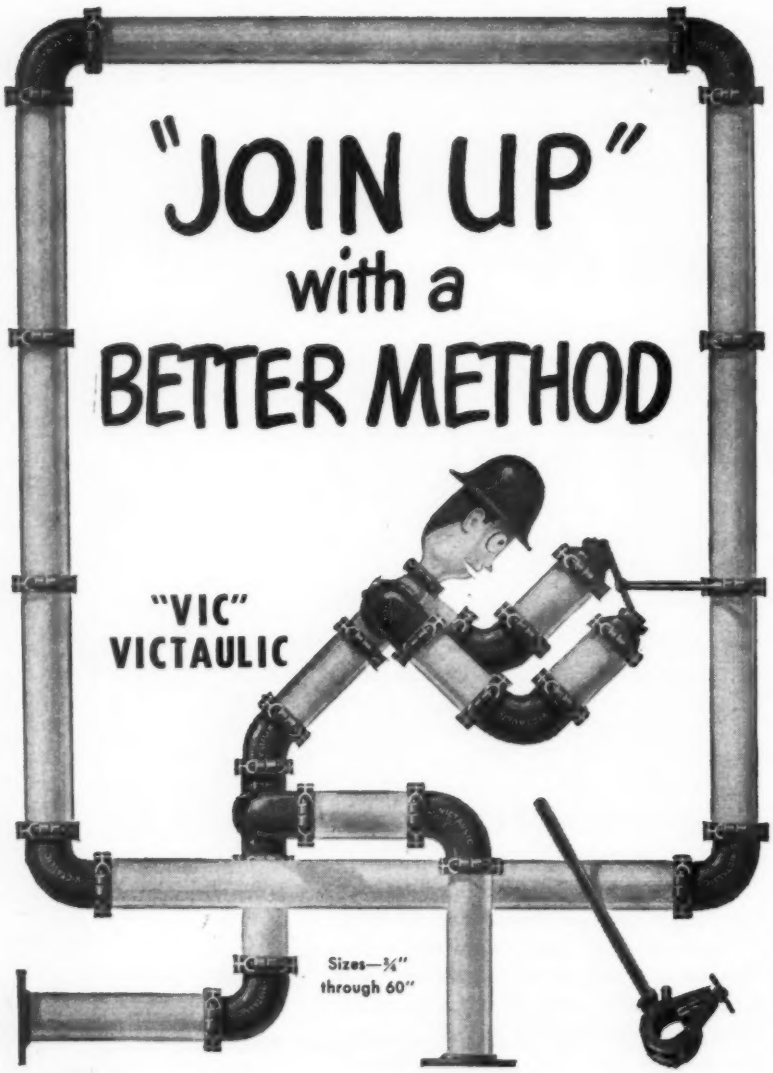
In other types of G-R apparatus, "RANGE-ABILITY" is obtained by designs which cover all duties. For example, the accompanying photographs also show various types of steam-heated and oil-heated reboilers; and the same plant is using many other designs of G-R Tubular apparatus as still feed preheaters, vapor condensers, oil-to-oil exchangers, gas heaters, gas coolers and aftercoolers.

No matter what may be your heat transfer requirements, be sure to consult Griscom-Russell for authoritative ratings and exactly suitable designs of proven performance.

THE GRISCOM-RUSSELL CO. 285 MADISON AVENUE, NEW YORK 17, N.Y.

GR-209

GRISCOM-RUSSELL



The VICTAULIC METHOD of piping can save you time, work, and dollars on construction and maintenance *right down the line.*

When you "join up" with the VICTAULIC METHOD you are assured of easy, quick, and dependable pipe connections. Pipe ends are "hooked up" in a jiffy with Victaulic couplings – only two bolts to tighten with a standard T-wrench! Victaulic pipe joints stay positive-locked, leak-proof ... they are built to stand up under extreme pressure, vacuum or strain conditions!

Grooving those pipe ends is a cinch with the VICTAULIC METHOD ... "Vic-Groover" grooves 'em automatically in half the time of a conventional pipe threader!

AND Victaulic offers a complete line of Full-Flow Elbows, Tees, and other Fittings designed for free-flowing efficiency ... giving complete versatility and dependability to the VICTAULIC METHOD.

"JOIN UP" with the COMPLETE VICTAULIC SYSTEM – a *better method* for efficient piping construction ... and the EASIEST WAY TO MAKE ENDS MEET.

* * *

Make *your* next piping job ALL VICTAULIC. Write today for these two: Victaulic Catalog and Engineering Manual No. 44, "Vic-Groover" Catalog No. VG-47.

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26TH VICTAULIC YEAR

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PIPE COUPLINGS AND FITTINGS

taxes would disappear. So would most of the problems of this world.

"Most of the evils and errors that trouble us today resulted from the failure of those who knew the truth to fight for it. Realizing that zeal is characteristic of the defenders of falsehood and unfair policies, those who seek truth and justice should be eager to push with all their energy for the goal line of a better world."

Leland K. Fishback, executive secretary, Indiana Petroleum Industries Committee, in "Hoosier Independent," September 1950.

Motorists Must Wait

"Motorists must wait a considerable time before improvements in gasoline can be reflected in the fuel mileage of their cars. While improvements in gasoline are constantly being made, the replacement of old cars with new averages only around 10 per cent a year. This makes it impossible for the full value of new fuels to be felt.

"Furthermore only a relatively small fraction of these new cars can be engineered to take full advantage of the highest-octane number fuels now available.

"When substantial increase in mileage is desired by the automobile user, other factors can contribute to his saving. Other design procedures can be employed by the motor manufacturer such as the reduction in engine size, the adoption of the smaller European-type car, and improved driving habits.

"Present low fuel costs provide little incentive for the driver to make any concession in the interests of saving gasoline."

D. P. Barnard, coordinator of research for Standard Oil Co. (Ind.), speaking before the North American Gasoline Tax Conference in St. Paul.

Oil on the Rails

"Failure of railroads to meet competition in the transportation of petroleum products when it first appeared is now making it increasingly difficult for them to hold the market still left to them and to regain a portion of what they have lost.

"There is a certain share of petroleum traffic that for good reasons belongs to the rails under a fair competitive level of cost.

"Certainly, where bypassing operations have gone into effect, the business is definitely lost to the railroads. Likewise, traffic to those bulk stations that have no rail facilities is something the railroads cannot hope to compete for.

"In 1949, with all the vast development in the petroleum industry, the nation's railroads actually moved less product than in 1936. The decline in rail transportation began before World War I. Sharp increases in rates placed refiners in a difficult position in shipping products into the prin-

Intense Spreading Action of Du Pont Special Oil Well Explosive No. 1 Increases Oil Flow

Fractures even the densest strata

Well operators in many fields have found that Du Pont Special Oil Well Explosive No. 1 penetrates even the densest strata. Its powerful spreading action fractures formations and promotes the free flow of oil . . . helps increase production.

Du Pont S.O.W.E. No. 1 also lowers over-all production costs three ways:

1. It is fast-loading . . . charges are strung quickly and securely on a cable.

2. Requires fewer entries into the hole . . . the cables carry a greater weight load.

3. Does not need torpedo shells . . . and absence of these simplifies clean-out and saves time.

Du Pont S.O.W.E. No. 1 is the safest well explosive known. It is so safe that even the impact of ball ammunition will not detonate it.

Ask your American Glycerin Section representative to tell you more about the many advantages of using Du Pont Special Oil Well Explosive No. 1.

AMERICAN GLYCERIN SECTION

Explosives Department

E. I. du Pont de Nemours & Co. (Inc.)

Tulsa 3, Oklahoma

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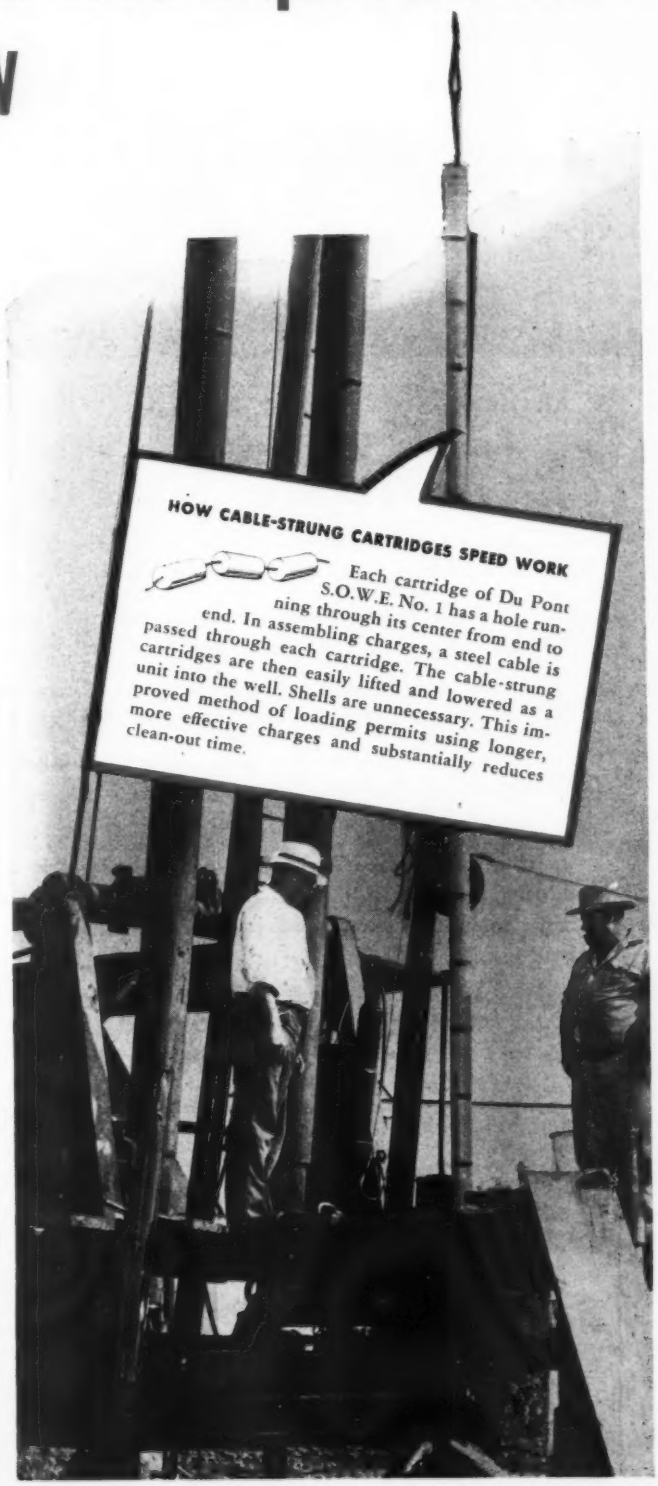
BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*


HOW CABLE-STRUNG CARTRIDGES SPEED WORK
Each cartridge of Du Pont S.O.W.E. No. 1 has a hole running through its center from end to end. In assembling charges, a steel cable is passed through each cartridge. The cable-strung cartridges are then easily lifted and lowered as a unit into the well. Shells are unnecessary. This improved method of loading permits using longer, more effective charges and substantially reduces clean-out time.

Over 100 Le Roi Drilling Engines
already at work in Scurry County

Le Roi's New, Improved RX Series Engines Provide Outstanding Acceleration, Lugging Power, Dependability

Yes, there's a reason why the new Scurry field favors the new, improved Le Roi RX Series Engines for their drilling operations.

Greater Lugging Power When You Need It — improved design gives better low speed — high load performance.

Faster Acceleration than Ever — thanks to simplified single carburetion and light aluminum pistons.

Longer Life, Less Maintenance — assured by full-flow by-pass oil filters, guided valve stem mechanism, improved cooling, and many other features.

That's why *Le Roi leads the field — in the field!* Ask your Le Roi distributor for the full story — he'll show you an improved RX Series engine in operation. Send for job-data reports, and our new bulletin.

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Appalachian Area
P. C. McKenzie Co., Pittsburgh

Canada
Lucey Export Ltd. — Calgary, Edmonton, Alberta.

cipal consuming areas. It resulted in the growth of pipe-line and motor-truck competition, cutting drastically into the rails' share of the business."

E. D. Sheffe, general traffic manager, Esso Standard Oil Co., speaking at the annual meeting of the National Petroleum Association in Atlantic City.

Health Habit

"Be your age! Act your age! Your doctor will tell you that those who do that usually find the most age.

"More than 90 per cent of the time that people lose from their jobs at Socony-Vacuum is due to illness and injuries incurred elsewhere, outside of regular working hours.

"Such illness and injuries frequently result in personal expenses for medical care as well as inconvenience to yourself and to fellow employes whose efficiency is interrupted by a break in your normal routine.

"It follows as a matter of course, then, that you help yourself as well as your company and your associates when you observe normal precautions and take good care of your health."

C. F. Beatty, director in charge of industrial relations, Socony - Vacuum Oil Co., Inc., in "Preserve Your Health."

Canadian Oil Output

"Where Canada is now capable of producing about 40 per cent of her crude-oil requirements, it is quite possible that the new discoveries would put this country past the 50 per cent mark on the road to self-sufficiency. Three-and-a-half years ago, when the Leduc discovery was made, Canada only produced 7 per cent of her crude requirements.

"A rise from 7 to 50 per cent is interesting enough in itself in so short a space of time. But the changes that have attended the growth of our oil reserves are to my mind even more significant. The center of gravity of the Canadian oil industry has moved westward. Where in 1947 it was economical to supply a large section of the prairies from eastern refineries, the refineries of Sarnia and Montreal could today scarcely hope to compete with the western industry in the prairies. At Edmonton, for example, gasoline either imported or made from imported crude would today sell at something like 7 to 9 cents above the price of the home-grown product. . . .

"This sharp turnabout in western oil is bound to bring changes throughout the western economy, because petroleum is a form of energy peculiarly suited to the needs of an area which is so large, so rich, and whose population is so widely distributed."

John R. White, executive vice president, Imperial Oil, Ltd., speaking to the Winnipeg Rotary Club, September 20.

. . . there's a local supply store handling MARSH GAUGES

MARSH ALONE HAS THE "RECALIBRATOR"—quickest and most satisfactory way to correct a gauge that has been knocked out of adjustment through improper handling.

Marsh branch plant at Houston offers shipment from stock, facilities for repairing all gauges

• Wherever you are, there's a supply of Marsh Pressure Gauges nearby. We have not only developed pressure gauges for every phase of the petroleum industry, we have also made them available wherever oil is produced, transported or refined. To further expedite distribution and service in the oil country there is a Marsh branch plant at Houston with complete facilities for servicing all makes of pressure gauges.

The harder you are to please, the better you will like these gauges that are engineered down to the last detail for every service encountered in the oil industry. In the Marsh Mastergauge you have an instrument guaranteed accurate within ½ of 1% of reading—a gauge with a finer monel and stainless steel movement, lathe turned bourdon tube and moistureproof, vaporproof case—a gauge that sets a new standard for quality and stamina.

The Mastergauge is made in types for every application—as a Christmas tree gauge, an oil country boiler gauge, and with effective diaphragm protection as a mud pump gauge. The line includes the finest of hydraulic gauges and Reid Vapor Test gauges. Ask for new oil industry bulletin containing convincing facts about Marsh Gauges.

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DOWELL SPINNER SURVEY located thief formation accurately when lost circulation threatened drilling

When remedial work is necessary to restore lost circulation, a key question is the exact location of the one or more thief zones. An accurate source of this information is a Dowell Spinner Survey, one of the Electric Pilot services.

Spinner Surveys made by Dowell engineers have made it possible to pinpoint the zones where the loss is occurring. With this information the remedial work can be accomplished more quickly and economically, and with the best possible chance of success. For example: After drilling to 8900 feet, loss of returns occurred when the mud weight was increased. No satisfactory material could be found to restore circulation, so a Dowell Spinner Survey was made. This showed the mud loss was occurring between 2195 and 2300 feet. This zone was squeezed off and drilling continued with full circulation.

Location of thief zones is only one of the proved uses of the Spinner Survey. Ask your Dowell engineer about using a Spinner Survey to determine the relative permeability of exposed zones in a producing or injection well, the relative production of zones in a producing oil or gas well, the location of holes in pipe and leaks in casing seats and bottom hole plugs.

DOWELL INCORPORATED
TULSA 3, OKLAHOMA
Subsidiary of The Dow Chemical Company

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SPINNER SURVEY

Ask your nearest Dowell station for complete information on these Dowell services and products: Acidizing, Electric Pilot Services, Plastic Service, Chemical Scale Removal Service for heat exchange equipment, Jelflake, Paraffin Solvents, Magnesium Anodes for corrosion control, and Bulk Inhibited Hydrochloric Acid.

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FOR OIL INDUSTRY CHEMICAL SERVICE

the OIL AND GAS JOURNAL

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WHAT A LEADING TECHNICAL EDITOR WROTE ABOUT ALUMINUM TRANSITS AFTER ANALYZING HOW GURLEY MAKES THEM

Reproduced from a full-length article in the December 1949 issue of MATERIALS & METHODS, written by H. R. Clauser, its Associate Editor. We will gladly send you reprints of the entire article on request.

Aluminum Used Successfully in Precision Instruments

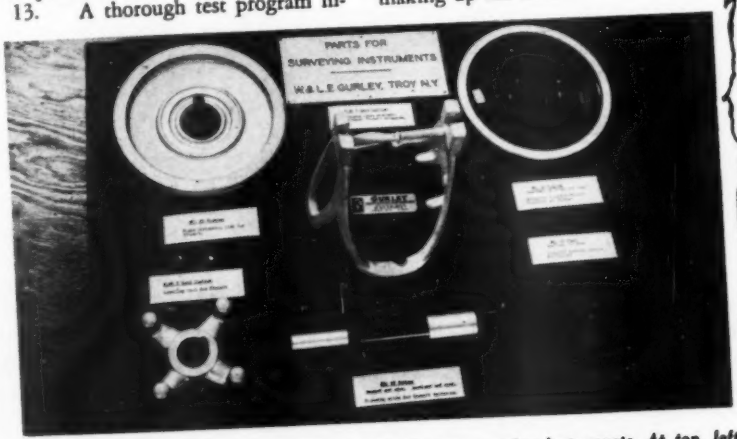
A PICTORIAL STORY

Requirements of accuracy during a long service life are controlling factors in selection of materials for engineering and surveying instruments.

● IN THE MANUFACTURE of precision instruments, the selection and careful processing of materials is of prime importance. Accuracy as well as long service life with a minimum of adjustment and repair are the quality standards that must be met, and to meet them, astute materials engineering coupled with expert workmanship are required. Perhaps no better example of the combination of these two factors can be found than at W. & L. E. Gurley, Troy, N. Y., where precision instruments are produced not only for engineering and surveying, but also for other fields such as meteorology and aeronautics.

Copper alloys and aluminum alloys are the principal materials used in the company's surveying instruments. One of the earliest uses of aluminum in this country was in a Gurley transit 73 years ago. And since that early application, aluminum has proved satisfactory in an increasing number of instrument parts. The main reasons for adopting the use of aluminum were: (1) light weight; (2) relatively high strength and yield point; (3) lends itself to precision machining; (4) good ductility; (5) relatively good corrosion resistance, especially in sulfur atmospheres; and (6) does not distort nor "grow" with age. The aluminum alloys most used at present are 14SW, 61ST, 356 and 13. A thorough test program insures against any differences in accuracy within a temperature range of —80 F and +165 F.

The accompanying pictures illustrate a number of the steps involved in the production of various parts making up the transit.



1—Shown here are the aluminum parts used in Gurley surveying instruments. At top, left and right is a 14SW forging for a horizontal transit limb before and after being machined, anodized and dyed. In the center is a sand casting of 356 alloy for the truss standard. Lower row, left to right, is a transit leveling head sand casting of 13 alloy, a swaged and spun tubing for telescope focusing slide of 51ST alloy, and a graduated vertical circle made of 61ST aluminum sheet which has been anodized and dyed.

You're So Right, Mr. Editor—

The first Gurley Aluminum Transit, built in 1876, was finally retired after 50 years of active service—and then for sentimental reasons only. It met every field "requirement of accuracy during a long service life"—as every Gurley Transit continues to do all over the world.

W. & L. E. GURLEY, 513 FULTON STREET, TROY, NEW YORK

Surveying and Engineering Instruments, Hydraulic Engineering Instruments, Standard Precision Weights and Measures, Paper and Textile Testing Instruments, Reticle Making Facilities, Aeronautical Navigating Instruments, Meteorological Instruments

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JOURNALLY Speaking

Mr. Driller

SPEAKING of drilling contractors, and we very definitely are in this issue, our staff recently made a census of them and some of the results appear on page 134. For instance, we'll bet you didn't know before that there are 89 tool pushers in California and 61 in the Rocky Mountains.

Another interesting bit of information is that 84 per cent of the drilling contractors are also producers of oil and gas. The census doesn't show it, but we'll make a little bet that most of the other 16 per cent would like to be producers, too.

Maybe that's the secret of how to become an oil magnate. First get a string of tools and be a contract driller. Then drill a well for yourself or on interest. Keep that up until you have enough oil to build a pipe line and a refinery at the other end of it, and then open a string of filling stations, and before you know it you are head of an integrated company. Just as simple as that. It's been done, and it will continue to be done unless Congress should pass some fool legislation to make oil men stick to one single phase of the business. So next time you talk to a driller, treat him with deference; you may be talking to Mr. Standard Oil of 1980.

And incidentally, Mr. Driller, if you have ambitions to be more than just a driller we suggest that you read our favorite oil publication regularly, because it's the one place where you can keep up with what's going on in all branches of this fast-moving industry.

Drilling Game

SO you think you know all about rotary drilling rigs? Here's a chance to test yourself—or your friends.

Open this issue to page 171 and fold the magazine back so you can't read the opposite page. There is a full-page picture looking down into a drilling rig, with numbers on various pieces of equipment. See how many of them you can name. For question No. 20, tell where the photographer stood to take the picture. Then turn back to page 170 and check your answers. Score 5 for each one correct. The man who gets 100 gets 100 (we aren't giving away any cigars). Some fun, eh?

If you flunk this test you had better read all the special material in this issue. Then you'll know your ABC's as well as your 1,2,3's of rotary drilling. Of course, some of this may look like kindergarten stuff to some of your old roughnecks and production men. But a lot of our readers are in other branches of the oil industry, and new ones are coming in all the time, so we figured a little "refresher course" might be in order.

On the other hand, if you made a perfect score on page 171, you can skip the rest of that article and go on back into the issue for the technical articles for drillers only. And in that case you will want to read the articles on drilling which our favorite oil publication will be running every week. In this issue we bundled up a bunch of special drilling material as a salute to the American Association of Oilwell Drilling Contractors which is holding its annual convention in Tulsa next week, but a lot more information on drilling will be carried all through the year.

Highbrow Stuff

WE thought Bert Linz was getting pretty classical a couple of weeks ago in his "Watching Washington" column when he was having some fun with the names being coined for new government agencies and wound up by pointing out that one of the suggestions sounded too much like the Latin word "meaculpa," meaning "my fault." But when the galley proof came back our erudite proofreader had added the notation: "The true expression is 'mea culpa, mea culpa, mea maxima culpa,' meaning 'through my fault, through my fault, through my most grievous fault.'" We're a highbrow bunch, all right.

—Henry D. Ralph

XUM

BAKER CASING SCRAPING WILL SAVE YOU MONEY, AND TIME, AND TROUBLE

There now are two types of Baker Casing Scrapers which safely, efficiently and economically remove bullets, burrs, hardened cement or mud, and even mill scale from the important "working surface"—the inside wall of the casing.

The results are so satisfactory that many operators now consider the use of a Baker Casing Scraper a "must" in well completion, or after every gun-perforating job.

CHOOSE THE TYPE TO EXACTLY MEET YOUR NEEDS

While the rotary rig still is up, and only hardened cement or a limited number of gun-shot burrs are to be removed, the time-tested Baker MODEL "B" Casing Scraper (Product No. 620-B) is recommended. It is usually run just above the bit while drilling out cement, and will completely remove protruding burrs as well as the thin sheath of cement left even after the maximum gauge bit has been used for drilling out.

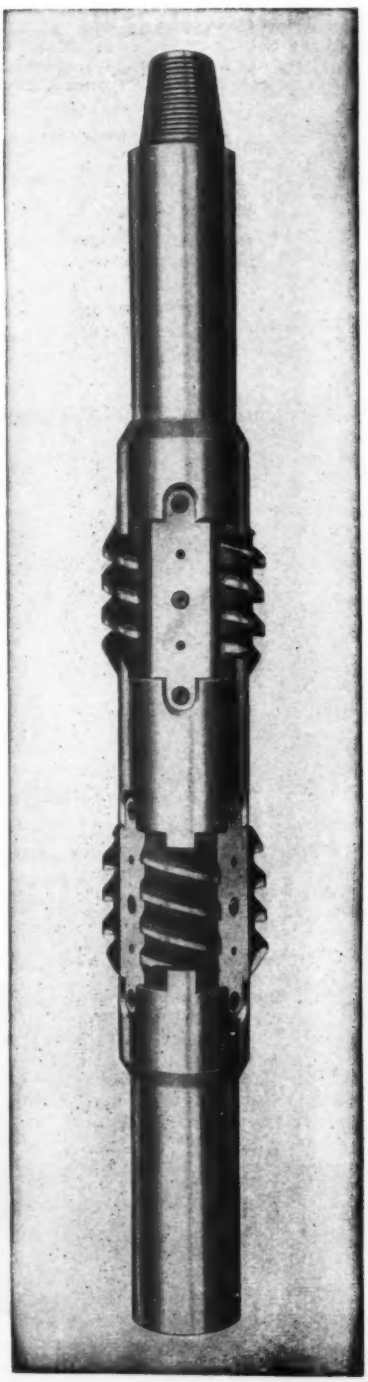
When there are several hundred gun-shot holes (with possible imbedded bullets); or if the hardened mud sheath is to be removed from top to bottom of the well, the new Baker ROTO-VERT Casing Scraper (Product No. 620-C) is recommended. The ROTO-VERT can be run on drill pipe for successful vertical scraping of obstructions as it is being lowered in the hole; followed by rotation if difficult well conditions make rotation necessary or desirable. Or it is run on tubing or a wire line for successful all-vertical scraping.

Either method leaves the inside wall of the casing "clean as a hound's tooth" safe for testing and completion, and ready also for all future down-hole work a year or ten years in the future.

NEW ROTO-VERT IS SAFE AND POSITIVE

The strong, simple construction of this efficient scraper is evident from the illustration which shows the rugged body on which six blade blocks are mounted, and held in position by blade block retainers. The blade blocks are set in two horizontal rows in a staggered position so that the blades overlap and will scrape the full 360° inside wall surface of the casing. The shearing edges are cut on a helix angle and provide a scraping, or shearing, action both while moving down the hole and while rotating. The thrust of each blade block, when rotating, is taken by a driving block which is welded to the body. Springs behind each blade block hold the heavily hard-faced cutting edges against the inner wall of the casing where they exert positive shearing action. ROTO-VERT blades will never screw down past a casing burr because their scraping edges follow the contour of a LEFT-HAND SCREW.

Contact the Baker representative in your area and find out how the reasonable rental is mighty cheap insurance for having *every* well in perfect condition for running tubing or liners, as well as any type of swab, tester, packer or cementing device.



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Drilling Costs

The fact that most oil and gas wells in this country are drilled by independent contractors rather than by their owners is evidence that drilling is a specialty in which an independent drilling contractor can do better than a major oil company.

Many large producers operate a number of their own rigs, as a check on costs or for experimental or other purposes, but most of them call on drilling contractors to put down the bulk of their wells. The universal experience, where records have been kept, is that contractors can drill cheaper.

One reason is that a drilling contractor usually operates with greater speed because his profit depends on quick completions and fast moves to new locations. His bids are based on his ability to keep down costs and maintain a high degree of efficiency.

The contractor's main problem is to make his bid low enough to get the job but high enough to yield a profit. This is a difficult task in a business as hazardous as drilling, where a long fishing job, an unanticipated formation, or other bad luck can cause ruinous delays.

Where a contractor drills a well at less cost than the owner could drill it he is performing a service to the consuming public by helping to keep down the price of oil. That is the advantage of the competitive system. But if he drills many wells below his own costs he goes broke and so do those who try to meet his prices. That is the disadvantage of the competitive system.

The way out of this dilemma is close knowledge of costs. This means careful cost accounting. Cost accounting is a pain in the neck to a man of action, an onerous chore with few tangible, readily apparent results.

But it is significant that the large and successful drilling contractors have cost-accounting systems which tell them precisely their elements of profit and loss. They know how much to add into a bid to cover the element of risk, depreciation of the rig, use of special equipment, an increase in the price of a given item of supply, and other applicable factors. When such a contractor figures a bid he knows the minimum below which he cannot afford to work. He also has the courage to refuse to bid below his true cost.

Many a small drilling contractor has gone broke by stretching his luck too far, ignoring his costs, or taking jobs below cost just to keep busy. This may benefit the individual well owner temporarily, but in the long run it is an economic loss to the oil industry. Oil companies which try to force bids down below the contractor's costs contribute to instability in this important branch of the industry, for no business can operate at a loss for long. Contractors who consistently ignore their costs are headed for failure.

The existence of scores of independent drilling contractors bidding against each other is ample guarantee that wells will be drilled at the lowest prices economically feasible. Careful cost accounting will make it reasonably certain that a contractor will not commit economic suicide. This is how an industry can keep solvent and yet efficient and competitive.

XUM

THIS WEEK

WASHINGTON—NPC calls for formation of independent agency to control oil, staffed by industry experts and separate from control agencies which will deal with coal, electric power, minerals. . . . ¶Interior Secretary Chapman assures industry of minimum government regulations in final oil-control setup. . . . ¶Priorities policy setup by NPA will give contractors producing for military first chance at scarce materials. . . . ¶Study to be made by NPA, producers and users of benzol, in effort to get more plant capacity under way. . . . ¶Interior Department takes over control of California tidelands oil fields under revised stipulation by Government and state. . . .

STEEL—I.P.A.A. finds that more steel is the only thing required by industry to provide military, civilians with adequate petroleum. . . . I.P.A.A. counsel tells NPC that oil, natural-gas industries will require 11,650,000 tons of steel for projected operations in 1951, or 17.4 per cent more than estimated for 1950. . . . ¶Steel-industry leader suggests oil business form cooperative distribution plan of its own to help beat the gray market in short-supply tubular goods. . . .

AVGAS—Near-future demands for aviation gasoline can be met with existing facilities, industry believes, but long-range planning will call for increased refinery expansion. . . . ¶Industry leader tells A.S.M.E. that chief stumbling block in avgas supply is fact that new military aircraft require higher quality fuels than those of World War II. . . .

INDUSTRY—Oil industry can do a good job in meeting petroleum demands if Government will aid it as much as possible, hinder it as little as possible, A.S.M.E. told. . . . Group hears ways to cut operational costs to improve maintenance efficiency. . . . ¶Pure opens new research and development laboratories at Crystal Lake, Ill. . . . ¶Future recoverable natural gas in U. S. will exceed 500 trillion cubic feet, A.G.A. members told. . . . ¶Texas Railroad Commission will attempt to bring about secondary-recovery operations in individual oil fields. . . .

ACTIVITY—Crude production for week ended September 30 averaged 5,840,660 bbl. daily, up 20,775 bbl. daily from previous week. . . . Well completions for the week totaled 872 compared with 934 for previous week and 750 for same week last year. . . . Wildcat completions for the week were off 4 wells to 164. . . . ¶Rotary rigs, operating in United States on September 25 reached 2,232 rigs, the high point since the first of July. . . .

TRENDS—Clean product stocks (gasoline, kerosine, and distillate fuel) in primary storage east of California on September 23 were 1,002,000 bbl. greater than at same time last year. . . . Clean stocks at the end of June were 15,265,000 bbl. less than at midyear 1949. . . . ¶District II stocks are now up 1,248,000 bbl. from last year. . . . District III is up 1,033,000 bbl. . . . District IV is up 760,000 bbl. . . . District I is down 2,039,000 bbl. . . .

INTERNATIONAL—High level of activity in petroleum industry indicated by enormous increase in spot tanker charters throughout world. . . . Rates continue to climb. . . . ¶Two sections of Trans-Arabian Pipe Line Co.'s line consolidated into one as final weld is made. . . . Completion of laying marks successful venture which overcame many obstacles. . . .

PIPE LINES—Ozark-Basin expansion program will provide additional crude-capacity outlet for Scurry County, Texas, reef pools. . . . ¶Regina, Sask.-Gretna, Man., section of Interprovincial line completed by Williams Brothers Corp. . . . ¶Work under way by Price crews on 309-mile section of Texas Illinois' new line between Hungerford and Texarkana, Tex. . . .

REFINING—Shell's Roxana, Ill., refinery resumes operations following settlement of month-long strike. . . . ¶Indiana Standard's Whiting refinery sets new record in daily crude runs. . . . ¶Production of petroleum coke to begin soon at Pan-Am Southern Corp.'s new El Dorado, Ark., installation. . . . ¶Steel drums for petroleum products classified as a critical shortage by Steel Shipping Container Institute. . . .

CONTRACT JOB.—The place of the drilling contractor in the oil industry is given special recognition in this issue of the Journal, and this picture illustrates a typical operation. It shows a rig of Gray-Wolle Drilling Co., Houston, working on the Pan American Production Co. 4 Gertrude Adams in Kelly-Snyder field, Scurry County, Texas. The special section on drilling contractors and equipment begins on page 133.

Control Plan Sought

NPC asks creation of independent agency to control oil; Chapman assures industry of minimum regulations

Bertram F. Linz

WASHINGTON.—The National Petroleum Council last week urged creation of an independent agency, headed and staffed by industry experts, directly under the Secretary of Interior but entirely separate from the other control agencies which deal with coal, electric power, and minerals.

This action came following an address before the council September 28 by Secretary Oscar L. Chapman, who told the group it could recommend the type of organization it wanted to have set up and he would accept its recommendations.

Addressing the largest attendance ever present at an NPC meeting, Chapman reported that government regulation of the oil industry under the Defense Production Act will be kept to a minimum and used principally to backstop the industry's own direction of its operations under an agency closely paralleling the former Petroleum Administration for War.

Chapman's statement cleared up confusion created by announcement the preceding day of the formation of a Minerals and Energy Administration with four units to deal with the industries for which President Truman made Chapman responsible, one of which would be for petroleum and natural gas. There is no intention, the secretary said, of tying oil in with coal, power, or minerals, and the council would be asked to elect the form of agency it wanted and to recommend a method of drafting the men to staff it.

Recalling the "powerful production force" of the industry in World War II and the postwar era of accelerated demand, Chapman told the council "it is my earnest belief that the most essential ingredient that has put the enormous power in the industrial production machine of this country has been the free play of competition."

It is clear, he commented, "that any aggressor nation today is afraid of our military power primarily because they respect and fear the industrial production power of this nation."

"Knowing as I do the inherent advantages of competitive enterprise to our general welfare," the secretary said, "I want all members of this council to know that it shall be my purpose, as petroleum administrator under the Defense Production Act, to so use the powers entrusted to me, as far as is humanly possible, to leave at the end of this emergency the same competitive relationships among the units of the oil and gas industry as exist today.

'I am fully confident that the oil and gas industry can, with reasonable governmental assistance, meet fully its responsibility of petroleum-products supply for national defense in any emergency that might arise. I expect to benefit by the experience of the last war, and therefore do propose the closest possible cooperation between Government and industry as the best means of meeting any supply program, however large, that may be called for."

Industry's job.—Industry must do the actual job of supply, Chapman said, and the Government's job will be to give it the necessary assistance to remove any road blocks.

"But we shall employ the minimum of regulation by directive," he added. "It is my earnest hope that as much as possible of this job be done by industry purely upon a voluntary basis."

Chapman disclosed that he had discussed the matter at length with J. R. Parten, president of Woodley Petroleum Co., who is serving as consultant to get the new organization set up, and had agreed that any agency established should be set up on vertical lines and headed by a deputy administrator who will report directly to the secretary.

Parten will be assisted by J. Howard Marshall, president of Ashland Oil & Refining Co., and former chief counsel of the Petroleum Administrator for War, who will serve as legal consultant.

Following the meeting, a special NPC committee immediately went into session to develop a list from which Chapman might draw a deputy administrator and other officials of the oil and gas agency.

Pending the organization of the emergency oil agency, Director Hugh A. Stewart of the Oil and Gas Division will head oil defense activities, with correction of present temporary shortages of aviation gasoline the first major problem facing him.

Avgas discussed.—The avgas situation was thoroughly discussed, but details were kept secret. It was disclosed, however, that both industry men and government officials feel the military program can be met although this may entail a lot of steps in which the industry would require government assistance, both financial and in the shape of Justice Department approval of its actions.

It was suggested, for instance, that isobutane, butylenes, and other components might be shipped from eastern refineries which cannot use them, to West Coast avgas producers. This would involve tank-car transportation at a cost which refiners could not bear and would necessitate some agreement under which the Government would assume the transportation expense. Other actions which will be taken will be designed to divert alkylate from nonmilitary gasolines, and the Government also may encourage the construction of additional productive capacity, by guaranteed loans or otherwise.

The situation is complicated, of course, by the fact that synthetic rubber and aviation gasoline use the same components, and neither program can be sacrificed for the other.

Domestic air lines, asked to change the specifications for their gasoline to use more tetraethyl lead and save more important components, protested it would involve a heavy increase in operating costs, and the Civil Aeronautics Board asked that such action not be taken unless absolutely necessary, but promised that if an order was issued they would go along.

There also was discussion of the automotive gasoline situation which developed that considerable time will be required to work out a procedure for reducing the octane rating, again to save alkylate. Following the session, Chairman Walter S. Hallanan said it was agreed that gasoline could be degraded several octane points without significant effect on high-compression motors, and that military demand at the present time is not so great that the reduction would be anything near that of the last war. There is no danger, he said, of any reduction in availability in the foreseeable future and recently completed and now-building capacity will add to the output, offsetting increases in military rquirements.

The council received interim reports from its committees on petroleum storage capacity and petroleum transportation and a full report from its committee on steel requirements, and heard an explanation of military policy on reserve officers from the Defense Department and on synthetic rubber from the Office of Rubber Reserve.

The next regular quarterly session of NPC will be held this month, Hallanan told the group, and last week's meeting will not substitute for the regular gathering.

During the quarterly meeting, various problems will be discussed, including a review of the progress which has been made so far in the defense production program.

XUM

Steel Requirements

Brown tells NPC that oil, natural-gas industries will need 11,650,000 tons for projected operations in 1951

WASHINGTON.—The petroleum and natural-gas industries will need 11,650,000 tons of steel for their projected 1951 operations, 1,727,000 tons, or 17.4 per cent, more than estimated for 1950, Russell B. Brown, general counsel of the Independent Petroleum Association of America and chairman of the National Petroleum Council's committee on steel requirements, reported last week.

The committee's report disclosed that this amount of material, to which must be added 585,863 tons of forgings and castings, will be required for the following: drilling of 43,400 wells next year, 1,200 more than are scheduled for 1950; installation of plants for natural-gas-liquid recovery, pressure-maintenance and recycling operations; extension of oil and natural-gas pipe lines, and other activities both at home and abroad. These will provide for an estimated demand, domestic and export, of 300,000 bbl. per day larger than this year and an increase in refining capacity of 154,800 bbl. per day in 1951 and 262,000 bbl. per day in 1952.

The report emphasized that the figures on demand and the steel requirements to meet it were based on the assumption the country would not be at war and "may not represent the nation's petroleum needs under a wartime economy." The determination of such wartime needs, it was pointed out, was beyond the scope of the committee's assignment.

"The top range of these estimates indicates increases in total petroleum demand of 4.4 per cent in 1951 over 1950, and 2.8 per cent in 1952 over 1951," the committee said in reporting that 1952 demand may run between 7,200,000 and 7,300,000 bbl. daily. "While this would represent a continuation of the normal growth in the use of petroleum, it should be noted that the top range of the average estimated 1951 consumption of 7,100,000 bbl. daily compares with a 1941 consumption of 4,370,000 bbl. per day—an increase of 2,730,000 bbl. daily or 62 per cent during the past 10 years. The top estimate for 1951 is 33 per cent larger than the total consumption during 1945, the peak year of World War II. These comparisons emphasize the growing importance of petroleum. A continual expansion of facilities, beyond any past levels, is necessary therefore in order to provide ever-increasing quantities of oil and gas."

The report cautioned that the health of the petroleum-equipment industry is equally as important as that of the oil industry and that basic mill products cannot be converted into useful form unless the manufacturing capacity of the equipment industry is preserved and maintained.

Foreign operations.—The committee's over-all requirements figures included estimates for foreign operations of the American industry based on the drilling of 1,644 wells in the Western Hemisphere in 1951, against 1,410 this year, and 141 wells against 123, in the Eastern Hemisphere; and the construction this year of 15,000 to 20,000 bbl. daily of new refinery capacity in the Western Hemisphere and 110,000 bbl. in the Eastern Hemisphere in 1951-52.

In the case of foreign pipe lines, the estimates cover the 450-mile Interprovincial Edmonton - Regina line with an estimated capacity of 100,000 bbl. daily for completion to Superior, Wis., in 1951.

On the basis of all operations, the committee estimated that 1951 requirements would include 437,000 short tons of structural shapes against 410,000 tons this year; 341,000 tons of bars against 319,000; 1,464,000 tons of sheets against 1,274,000; 1,758,000 tons of plates against 1,632,000; 2,040,000 tons of oil country goods and pressure tubing against 1,926,000; 3,256,000 tons of line pipe, 16-in. and larger, against 2,498,000; 2,112,000 tons of smaller line pipe against 1,672,000; and 242,000 tons of miscellaneous steel products, against 242,000.

Requirements of the several branches of the industry are shown in the accompanying table.

ESTIMATED TOTAL STEEL REQUIREMENTS BY FUNCTIONAL DIVISIONS OF THE PETROLEUM INDUSTRY

	1,000 short tons		Change	
	1950	1951	1,000 short tons 1951	Per cent 1950
DOMESTIC OPERATIONS				
Production:				
Oil and gas	2,732	2,888	156	5.7
Natural gasoline and pressure maintenace	285	352	67	23.5
Subtotal	3,017	3,240	223	7.4
Transportation:				
Oil pipe lines	948	1,304	356	37.6
Tankers	412	195	—217	—52.7
Barges	126	170	44	34.9
Tank cars	46	170	124	269.6
Truck tanks	18	24	6	33.3
Subtotal	1,550	1,863	313	20.2
Refining	565	654	89	15.8
Marketing:				
Plant facilities	561	620	59	10.5
Containers	733	908	175	23.9
Consumer storage	218	191	—27	—12.4
L.P.G. plant facilities and consumer storage	498	538	40	8.0
Subtotal	2,010	2,257	247	12.3
Natural-gas transmission	2,251	3,023	772	34.3
Total domestic requirements	9,393	11,037	1,644	17.5
Foreign operations (50 per cent or more United States owned):				
Western Hemisphere	393	415	22	5.6
Eastern Hemisphere	137	198	61	44.5
Total foreign requirements	530	613	83	15.7
Grand total	9,923	11,650	1,727	17.4

Benzol Study

NPA seeks to get added plant output under way

WASHINGTON. — National Production Authority officials are scheduled to meet with producers and large consumers of benzol this week to discuss means of getting additional plant capacity under way.

The benzol problem has been a lively subject of inter-agency controversy for a number of weeks, with some Interior Department officials plugging for construction of a plant to produce it by hydrogenation of coal. Other interests, viewing this as an effort by the department to get into synthetic liquid-fuels production by the back door, charge that such a plant would cost $250,000,000 and take 2 years to build and contend that a plant to produce around 40,000,000 gal. a year from petroleum could be put up in a matter of months at a cost of about $50,000,000.

The controversy reportedly reached the point where it was taken to Chairman W. Stuart Symington of the National Security Resources Board, President Truman's coordinator of defense production activities, who is said to have tossed the coal-plant idea out the window. An interdepartmental committee that worked on the problem also reported that expansion of output should be with petroleum rather than coal or coke.

The NPA-industry meeting this

week is scheduled to go into the question of whether new plant facilities should be financed by the industry or the Government. Officials of the Oil and Gas Division are urging that a prompt decision be made on all points involved, because of the urgent need for benzene for the aviation - gasoline and synthetic - rubber programs.

Priorities Policy

Contractors producing for military are to be given materials priority by new National Production Authority

WASHINGTON. — A general order giving priority in the procurement of materials to contractors producing for the military this week was the first step to be taken by the new National Production Authority to spread the supply of scarce commodities.

The NPA order limits priorities to a narrow range of directly military products, but it will be supplemented later by orders extending priority to the things needed for the production of military goods such as machine tools, freight cars and, presumably, tubular goods and refining equipment.

The regulation authorizes the assignment of a "DO" (defense order) rating to orders from the military, which will apply not only to prime contractors but may be extended by them to suppliers of materials, products and components used in the end item. The term "materials" is defined as "any raw, in process, or manufactured commodity, equipment, component, accessory, part, assembly, or product of any kind." While this will not include petroleum or gas, which are under the jurisdiction of the Interior Department, producers of oil and gas will be subject to the NPA regulations with respect to other materials and products used by them.

General allocation of scarce metals is seen as following these priorities actions, and it is here that the NPA is most likely to run into trouble. Present indications are that in dealing with this problem, NPA will determine the amounts to be set aside for specific uses and permit producers to distribute the remainder as they see fit which means there will be a mad scramble by civilian manufacturers.

Meanwhile, pressure is increasing in the government agencies for general price and wage control rather than the selective price controls which President Truman favors. This agitation is based on the argument that to control a few basic materials while leaving others unrestricted would lead to "bulges" in the price structure; this in turn would bring demands from labor for wage increases and higher wages would bring further distortions.

The argument over wage control will have political connotations. Organized labor is opposed to wage controls and the President is believed to be sympathetic. But experts say price control must be accompanied by wage control and, again, it is impossible to keep wages down in a few industries and leave them free to rise in others.

Although most Congressmen left Washington immediately upon the suspension of the session until November 27, members of a few committees stayed on to clean up investigations that were under way.

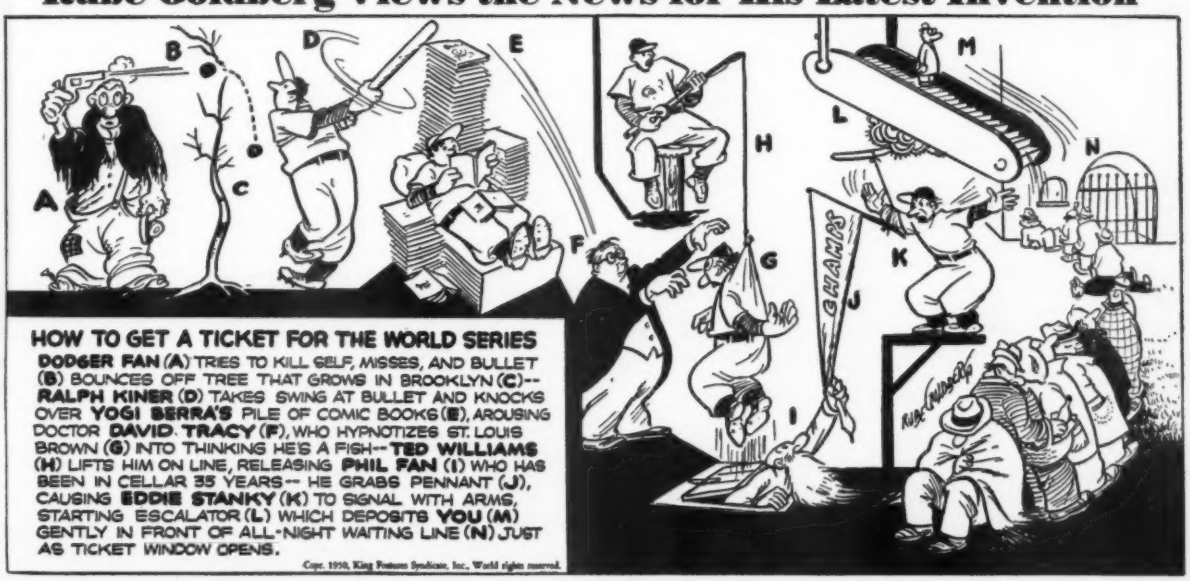
The defense activities subcommittee of the House interstate commerce committee held another closed-door session last week to go into the question of aviation-gasoline supply. Following the meeting, Chairman Robert Crosser of Ohio said there is a serious shortage of the product but steps have been taken to deal with it in which the Government is receiving the "full cooperation" of the oil industry.

A Senate labor-management subcommittee holding hearings on maritime hiring halls went into charges by the A. F. of L. Seafarers International Union that Cities Service Oil Co. engaged in wire-tapping and the use of labor spies to prevent the union from organizing the crews of 16 of its tankers.

As a result of increased military demand, the Bureau of Mines has resumed operations, on a limited scale, at the Amarillo, Tex., helium plant which was closed down and put on stand-by status at the close of the last war. The plant, opened in 1929, has a rated output of 36,000,000 cu. ft. of helium a year but the bureau did not state how much is to be produced there to supplement the 60,000,000 cu. ft. produced at the Exell, Tex., plant.

Although the outbreak of fighting in Korea resulted in heavier demand for helium, the bureau said, private consumption has been increasing

Rube Goldberg Views the News for His Latest Invention



HOW TO GET A TICKET FOR THE WORLD SERIES

DODGER FAN (A) TRIES TO KILL SELF, MISSES, AND BULLET (B) BOUNCES OFF TREE THAT GROWS IN BROOKLYN (C)-- **RALPH KINER** (D) TAKES SWING AT BULLET AND KNOCKS OVER **YOGI BERRA'S** PILE OF COMIC BOOKS (E), AROUSING DOCTOR **DAVID TRACY** (F), WHO HYPNOTIZES ST. LOUIS BROWN (G) INTO THINKING HE'S A FISH-- **TED WILLIAMS** (H) LIFTS HIM ON LINE, RELEASING **PHIL FAN** (I) WHO HAS BEEN IN CELLAR 35 YEARS-- HE GRABS PENNANT (J), CAUSING **EDDIE STANKY** (K) TO SIGNAL WITH ARMS, STARTING ESCALATOR (L) WHICH DEPOSITS **YOU** (M) GENTLY IN FRONT OF ALL-NIGHT WAITING LINE (N) JUST AS TICKET WINDOW OPENS.

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WATCHING WASHINGTON

Bertram F. Linz

'Honeymoon' Is Over

Despite all predictions to the contrary by government officials, the prosperity honeymoon is over and business and industry are about to learn the sad facts of life. And Commerce Secretary Charles Sawyer, who will administer the priority and allocation controls of the Defense Production Act, is the man who will do the educating.

Sawyer, who when appointed, was expected to be merely another office holder but has developed to be one of the main props of the administration, isn't pulling any punches when he talks of what is ahead for business as, for instance:

"The happy period of peace and prosperity which we enjoyed since the close of World War II is, for the time being at least, at an end. There is no advantage in pretending otherwise. Regardless of the outcome of the battle in Korea, we have embarked upon a program which will put critical strains upon our domestic economy. Serious shortages, heavy taxes, and problems of inflation will tax our ingenuity and self-control and strength to the utmost; and this will go on for years.

"It is completely unrealistic to assume that after a brief interval the problems we now face in Korea will be ended and we can go back to 'business as usual'."

In talking about his job, Sawyer intimates there will be a lot of controls, designed to keep the economy compact. not just controls here and there. While they won't be his responsibility, he implies that general price and wage controls are in the cards and not just the "selective" regulations of which President Truman has spoken.

Rosie's Return

The administration's defense program is going to do a lot of things to the United States—most of them unpleasant.

Our annual production of goods and services is seen by government economists as increasing from its present $285 000.000,000 level to $350,000,000,000 or $400,000,000,000 by 1955, possibly earlier, but government spending also will increase and in 5 years will be around $100,000,000,000 a year, which means much higher taxes on corporations and individuals than we have seen yet.

To reach these figures business will have to increase vastly the productivity of present plants and invest tremendous sums in new plant and equipment, about one-third of all that is now so invested.

The armed forces will continue to take men from industry, well over 2,000,000 in the next 21 months; that means a terrifically tight male labor market and the return to work of "Rosie, the riveter."

President Truman has warned that the new wartime economy will run for years. Most people, perhaps unconsciously, take that to mean a few years but government economists are talking in terms of 15 to 20 years—almost a full generation.

Amortization Tangle

The new tax law signed by President Truman last month contains a provision for accelerated amortization of investments in new plants contributing to the defense effort, but so far nobody knows where the certifying agency will be located and as a result very few contracts for plant construction or expansion are being signed.

Under the law, the cost of such new facilities can be amortized over a period of 5 years provided they are certified as necessary for national defense, a matter of some importance to industry in view of the impending imposition of a stiff excess-profits tax which will be retroactive to at least October 1.

Officials have noted that already the lack of machinery for the certification of new construction has slowed down plans for expansion of output of many commodities which are in short supply.

But industry remembers what happened during the last war when the certifying agency, the War Production Board, refused to certify any facility or new construction acquired or undertaken prior to the issuance of the certificate, and is unwilling to risk a repetition of that situation.

Some of the areas in which the Government is anxious to secure increased production involve commodities important in refining. Industry reportedly is ready and willing to undertake the necessary expansion but only if it can get started before costs skyrocket and make it too expensive. Any great delay in getting the accelerated amortization program under way might result in the Government having to finance plants, as it did in World War II.

gradually and during the fiscal year ended last June 30 amounted to 63,311,000 cu. ft. Present indications are that 80,000,000 cu. ft. will be required during the current fiscal year.

Projects support.—The Munitions Board, it was learned this week, is preparing to throw its support behind new oil and pipe-line projects which will aid rearmament if they run into difficulties after priorities and allocations are imposed.

A number of companies have laid their plans before the board, which is listing those which will contribute to military supply, and if controls threaten to impede their construction will do what it can to expedite matters. A number of suggestions as to procedure have been considered, one being that if controls appear imminent the NPA might be asked to hold them up until the most vital projects have been cared for. As an alternative, the board might support requests for high priority for such projects. Board officials are highly interested in the steps taken to increase oil supply and in being advised of all new projects, particularly for refining and pipe-line capacity.

The Department of Labor also prepared to get into the defense production picture. Charged with administration of manpower controls, Secretary Maurice J. Tobin is preparing to set up an Office of Defense Manpower, patterned after the World War II Manpower Commission. The office will be headed by an executive director who has not yet been selected.

Tidelands Control Shifted

WASHINGTON.—The Interior Department took over control of the California tidelands oil fields this week under the revised stipulation agreed to by the federal Government and the state in August. L. G. Snow of the Los Angeles office of the Geological Survey was instructed by Secretary Oscar L. Chapman to exercise the department's authority.

Under the amended stipulation the state will turn over to the federal Government all rentals, royalties, and other receipts from leases beginning October 1. The state's receipts between June 23, 1947, the date of the Supreme Court decision giving the United States paramount rights in the California tidelands, and September 30, 1950, will be segregated.

Provision is made for certain expenditures, not to exceed $12,000 a month by the state land commissioner and $50 000 annually by the department. The state agreed to make monthly production reports, and the department was authorized to request the state to call for bids on new leases and the state may enter into new leases under certain conservation conditions.

More Steel Needed

It is the only thing required to maintain adequate oil supply for military and civilian needs, I.P.A.A. finds

Henry D. Ralph

ST. LOUIS.—More steel is the only thing needed to maintain an adequate supply of petroleum for military and civilian needs provided producers are permitted to carry out their programs without interference, it was agreed by the Independent Petroleum Association of America at its annual meeting here October 2-3.

The shortage of oil-country tubular goods was the chief topic of discussion among the nearly 800 oil producers in attendance. The opinion was unanimous that drill pipe and casing has disappeared from the market entirely although a spokesman for the steel industry insisted that the production of tubular goods is sufficient to meet all requirements.

Of equal interest were the reports from Washington that the Government and the National Petroleum Council have agreed on an organization to handle the oil industry's war problems which will be separate from other activities and will be manned by representatives of the industry itself.

General confidence in the industry's ability to meet requirements was bolstered by the report of the economics committee that the current rate of production and imports of crude oil is about 200,000 bbl. per day higher than the average demand which will prevail during the next 12 months, even after allowing for an adequate increase in working stocks.

Steel.—Henry J. Wallace, vice president in charge of sales of National Tube Co., Pittsburgh, told the association that the production of oil-country tubular goods this year will be ample to fulfill the oil industry's drilling program provided operators do not attempt to build up their inventories.

Wallace referred to a July report of I.P.A.A. that 1,568,000 tons of tubular goods would be needed to drill 40,000 wells this year and declared that production less exports will be 1,569,000 tons, or slightly more than what the industry says it needs. He said that the apparent shortage is due to a decline in users' inventories last year and a current effort to replenish these inventories by many operators at one time.

Under the new Defense Production Act, Wallace said, there is every reason to believe that the oil industry will obtain sufficient steel to meet its needs, and he recommended that the industry set up its own machinery for allocating steel on a voluntary, cooperative basis.

"The most satisfactory form of allocation," he said, "is the one now being employed. It is inconceivable that a government agency, unfamiliar with your problems, could do a better job of distributing to you than the oil-well-supply houses who are your regular suppliers, particularly if the oil-producing industry on a voluntary basis takes steps to insure the most efficient use of the tonnage provided, by proper well spacing and by all other practical means."

The association reacted by adopting a resolution calling on the Secretary of the Interior to call a joint conference of oil producers, steel-mill operators, and supply houses to formulate a voluntary program to:

1. Allocate sufficient steel to meet the essential material requirements for petroleum exploration, development, and production.

2. Distribute available supplies of oil-field materials for current use.

3. Establish regional pools or reasonable inventories for priority delivery by industry committees to meet essential needs of operators without established customer relationships for unforseeable and unscheduled drilling operations.

4. Avoid stock piling of materials in short supply.

5. Encourage the most effective use of materials by the petroleum industry through cooperation with state regulatory bodies in the administration of state conservation programs.

During floor discussion of the steel situation several members insisted that the association take steps to see that independent producers have adequate representation on any government or industry bodies set up to deal with allocations. Declaring that smaller operators are not now getting their share of tubular goods, Bryan W. Payne, chairman of the materials committee, announced that he is appointing a committee to enlist independent producers to serve on such bodies.

It was also suggested that the industry police the distribution of tubular goods to see that there is no hoarding or stockpiling and particularly to prevent reselling in the gray market. Wallace brought applause when he promised that his company would refuse to sell more steel to any operator shown to have resold steel or used it for purposes other than these for which ordered.

Supply.—Demand for petroleum products in the United States for the first time in history will exceed 7,000,000 bbl. per day during the next 12 months, it was forecast by the association's economics committee. This was based on the assumptions that military and industrial activity will continue at about present levels. This forecast is an increase of 5.7 per cent above the total requirements of the last year.

In spite of this record demand, the committee estimated that supply will average 7,230,000 bbl. daily if production and imports are continued at current rates. This figure was calculated prior to the recent action of the Texas Railroad Commission in reducing allowables by about 100,000 bbl. daily in October, and included imports of 850,000 bbl. daily. The demand figure anticipated an increase in total stocks of 24,500,000 bbl. or 4.2 per cent, during the next 12 months.

Government relations.—Oscar L. Chapman, Secretary of the Interior, sent a letter of greeting to the association praising the part of independent operators in discovering and maintaining petroleum reserves and saying: "I wish to assure the members of your association that as Secretary of the Interior and as Petroleum Administrator under the Defense Production Act I shall, as far as humanly possible, protect the competitive position of the independent petroleum operator."

In reply the I.P.A.A. adopted a resolution expressing appreciation for this promise and pledging full cooperation in the program.

On other phases of relationships with the federal Government however, the association was in a less cooperative mood. It adopted resolutions denouncing attempts to interfere with the percentage depletion and other aspects of the industry's tax treatment, denouncing the attempt of the Federal Power Commission to regulate production and gathering of natural gas, and denouncing pending legislation to permit the Government to renegotiate the price of crude oil from which refined products are sold to the Government.

A feature of the meetings was a forum of industry leaders discussing production, distribution, conservation, and other phases of the petroleum industry in which all agreed that the industry is well prepared to meet any national emergency.

All association officers were reelected, including J. Ed Warren, president; H. B. Fell, executive vice president; and D. R. Snow, treasurer.

Cost-Cutting Session

A.S.M.E. discusses ways to trim operational expenses in all phases of industry; 37 technical papers presented

Leigh S. McCaslin, Jr.

NEW ORLEANS.—How to cut operational costs in all phases of the petroleum industry in order to improve maintenance efficiency was the major topic for discussion at the 1950 petroleum mechanical-engineering conference of the American Society of Mechanical Engineers, held at the Roosevelt Hotel here September 24-28.

The meeting, with a theme of "Cost Reduction," was attended by 400 engineers who heard 37 technical papers on production, refining, and transportation.

As an example of how an intensive cost-reduction program will reduce operational expenses, H. J. Voorhies, general manager of Esso Standard Oil Co.'s Baton Rouge refinery, explained the company's program, which was instituted at war's end when it was found that costs had risen several fold as compared with prewar years.

First step in the program, he said, was an attempt to develop the proper attitude among workmen. Along this line, Esso instigated three types of meetings which are concerned primarily with operating costs. These meetings are: monthly department-wide, annual refinery-wide, and annual company-wide gatherings. Free exchange of ideas and competition between departments are encouraged.

The second part of Esso's program is a training program. A unique new idea which is a part of this training is that of job rotation for supervisors. This rotation is not kept on an intra-department basis. As explained by Voorhies, "Supervisors in the maintenance department exchange hats with men in process operating departments. Supervisors in technical groups change seats with men in operating groups."

To coordinate the cost-reduction program, a cost coordination group of five engineers has been set up. They review operating costs and compare them with other Esso refineries. From this work they are able to "highlight undesirable cost trends and promote interest in cost control."

As an example of the beneficial results of Esso's cost-cutting program, Voorhies cited maintenance operations in which almost half of the refinery's 7,500 employes are engaged. Spectacular results have been achieved by means of the following:

"Additional capable technical men were assigned to the maintenance organization. Maintenance manhours were budgeted on an annual basis to each operating department. Overtime was all but eliminated. Competition among crafts was encouraged by comparisons of the trends in efficiency of all crafts. We spent hours in planning important jobs, such as turnarounds, in order to save days in their performance. Above all, we purchased new labor-saving tools."

Technical sessions.—One of the best-attended technical sessions of the meetings was the discussion of "Crankcase Explosions" by F. V. Cook, master mechanic for Stanolind Pipe Line Co. This problem has seldom been discussed publicly and apparently there is much interest in it among the industry. Six prepared discussions and much informal discussion followed Cook's paper, but no conclusive decision was reached as to means of coping with the problem.

Latest developments in offshore producing methods, including the electrification of offshore platforms, were discussed by G. W. Osborne of The California Co. Calco has recently laid 19,000 ft. of steel, armored submarine cable to transmit electrical power to its Bay Marchand field in the Gulf of Mexico. This special cable contains three main power wires for three-phase a.c. current at 13,800 volts, plus three pairs of small wires which may be used for telephone communication and remote control of producing facilities.

The newly designed production facilities which Calco is installing offshore to utilize electric power feature automatic controls. This has been done to lessen the effect of weather on offshore operations. Pumpers and gagers will be able to spend much less time at sea with consequently safer operating conditions.

In another discussion of offshore operations, A. F. T. Seale of Kerr-McGee Oil Industries, Inc., challenged the mechanical-engineering profession to provide improved machinery and equipment to cope with the many drilling problems in the Gulf of Mexico. He particularly commented that the principle of rotary drilling is due for research and study. He predicted that "the advent of commercial atomic power and possibilities in the field of electronics for the disintegration of formation ahead of the bit" would probably result in "some radical departures from the conventional."

The ever-present problem of efficiently pumping deep producing wells came in for a share of attention from two papers. D. G. Knox, National Supply Co., reviewed the various gas-lift methods of producing deep wells. He concluded that the multiple-stage free-piston plunger lift "offers one of the best solutions to deep production when gas is available." In the multiple-stage plunger lift, two or more plungers are operated simultaneously in the same tubing string rather than the more conventional one.

The second paper on deep producing wells consisted of a detailed analysis of the design and operation of hydraulic long-stroke pumping units. These units, which have long been popular in California, are becoming more common in recent months in the Mid-Continent and Gulf Coast areas. P. J. Donnelly of W. C. Norris, Inc., prepared the long stroke pumping unit paper.

Members of the executive and general committees of the A.S.M.E. petroleum division gather for a picture in the Roosevelt Hotel. Back row: O. L. Lewis, C. F. Braun & Co.; F. J. Daasch, Gulf Oil Corp.; F. H. Warren, Ohio Oil Co.; and O. B. Schier, meetings manager, A.S.M.E. Front row: D. P. Thornton, Petroleum Processing; E. W. Jacobson, Gulf Research & Development Co.; J. M. Sexton, M. W. Kellogg Co.; H. J. Voorhies, Esso Standard Oil Co.; and P. E. Frank, Sinclair Refining Corp.

Portable sampler.—A new portable automatic sampler for crude pipe-line operations was disclosed at the meeting by W. E. Roads, Service Pipe Line Co. It is a self-contained constant-rate sampler capable of automatically taking samples at flow-rates as low as 1 cc. per minute. This is done without the need of external connections to a power source. The unit was designed specifically to obtain samples of crude in lines near small field gathering stations and at junctions where field lines meet main trunk lines.

Two highly specialized papers on oil-well casing were presented. B. E. Curran, Kerotest Manufacturing Co., set forth a procedure for designing high-strength casing strings for deep wells. J. A. Reed, II, and H. H. Meredith, Jr., Humble Oil & Refining Co., outlined a method for determining the well-head loading of casing used in offshore wells. Wave forces and the fact that casing columns are unsupported for long distances above the Gulf bed, create special problems in offshore casing programs.

The important problem of fatigue failures between tool joint and drill pipe during rotary drilling operations was discussed in detail by William S. Bachman, Hughes Tool Co. He concluded that new-type connections have "practically eliminated" failures at the tool joints.

Observations by B. B. Morton, International Nickel Co., on protecting steel structures exposed to sea water were received with considerable interest. Morton concluded: (1) Areas below water level are best protected by an impressed current; (2) the splash area is difficult to protect, but present knowledge indicates that encasing this area in concrete or sheathing it with a resistant metal may work; and (3) the area above the splash area can be best protected by zinc coatings or by paints.

Chairman of the New Orleans arrangements committee for the meeting was C. R. Drauchon, Jr., Esso Standard Oil Co. Members of his committee included: C. S. Pugsley, Jr., M. P. Watson, R. L. Nall, G. Cary Carpenter, David Moodie, Walter J. Verlander, Allen W. Betz, William H. Saunders, Jr., Allen H. Jensen, James M. Todd, and Francis B. Blackstone.

During the meeting it was announced that J. M. Sexton, W. M. Kellogg Co., will be the new chairman of the national executive committee. A. C. Stutson, Socony-Vacuum Oil Co., Inc., was elected a new member of the executive committee.

H. J. Voorhies, general manager, Baton Rouge refinery, Esso Standard Oil Co., addresses the opening session of the fifth annual petroleum conference of the A.S.M.E. Others in the picture are: J. M. Sexton, M. W. Kellogg Co.; James M. Todd, James M. Todd and Associates; deLesseps S. Morrison, mayor of New Orleans; and Waldemar S. Nelson, Bedell & Nelson. Sexton was elected new chairman of the petroleum division's executive committee during the New Orleans meeting, succeeding E. W. Jacobson, Gulf Research & Development Co.

Oil for Mobilization

Industry can meet needs in event of war if government helps, not hinders it, Brown tells A.S.M.E. conference

NEW ORLEANS. — The petroleum industry stands ready to supply all military and civilian needs in event of another major world conflagration, providing the Government helps as much as possible and hinders as little as possible, Bruce K. Brown, president of Pan-Am Southern Corp., and chairman of the Military Petroleum Board, told members of the American Society of Mechanical Engineers here last week.

Brown said that "since the oil industry will quite apparently have to go to work on this special job, it would like to be permitted to concentrate on the job. It wants to work for Uncle Sam without having to fight him for its life at the same time."

The speaker said that industry does not like government regimentation or control, "but if it is necessary, it asks only that it be intelligent control aimed at meeting the military needs, rather than advancing some scheme to destroy the industry."

Brown reminded the group that the industry overcame many hazards and difficulties to successfully keep up with demands during World War II, and said:

"Should we have to fuel another major war—a World War III—the industry will again perform superbly if given a chance."

Citing the aviation-gasoline supply problem, Brown said that the "principal problem at the moment seems to be supplying the Air Force and naval aviators with adequate supplies of 'super-duper quality' aviation fuels. Apparently, it will take some government assistance and regulatory activities to help us do what we cannot legally do ourselves under the structure of the Sherman Act and the Clayton Act."

Brown said that the principal potential deterrents to the success "we know we could achieve" seem to be the same as they were at the start of World War II. "One is the necessity for constructing an agency staffed with skilled oil men and dedicated to the proposition of supplying the military—not to the accomplishment of further socialism by indirection."

BRUCE K. BROWN

Cites current suits.—He touched on the current government suits against West Coast oil companies which seeks

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to break them up, and said that industry on the West Coast has to be called on to fuel Pacific wars, and "at present it is doing a superb job.

"It is supplying about half of all the aviation fuels needed by our armed forces—although it has only about 20 per cent of each of the total producing capacity and refining capacity to do the job with," he said. "And right now it is under threat of absolute destruction by legal attacks."

Brown said that an executive of one West Coast oil company showed him in Washington recently the job cut out for him by the Department of Justice in answering what he said was a half million separate questions. "He estimates that it will take 90 man-years of time for his company alone to answer questions that may never ever see the light of court—to say nothing of being germane to any issue that may arise in the mind of a judge who may some time, eventually, try the case.

"Surely this is fiddling while Rome burns. I maintain, as humbly as I can, that these oil men can do more good helping the military and the Department of Interior produce supplies to kill Communists than they can answering vexatious interrogatories," he said.

Avgas supply.—In presenting before the group the problem facing the industry in meeting military requirements for aviation gasoline, Brown said that the chief stumbling block to meeting the requirements is the fact that new military aircraft require a higher fuel than those of World War II, containing the special ingredient "alkylate."

The shortage occurs, he said, not in the fact that alkylate production is lower, but that a much higher content is required by the new engines.

"Whereas during World War II we were able to produce the so-called '100-octane aviation gasoline' by using about 35 per cent of alkylate in combination with other ingredients, today's specifications require a much higher product — one in which we have used 85 per cent or more of the precious alkylate.

"Some airplanes still operate on the old specification which was '100/130.' The new planes (aside from jet planes which use a kerosine-type fuel) require a 115/145 specification, which means nearly pure alkylate."

"It is prefectly true," he said, "that by degrading civilian automobile gasoline we can marshal the high-octane ingredients available to petroleum refiners in such a way as to make them able to produce more aviation gasoline of high quality. This merely means that we can concentrate more and more high quality ingredients in aviation gasoline if we remove them from motor gasoline."

Brown, pointing out the problem of increasing alkylate production, said that to produce even the relatively small quantities of avgas required for the present period, it is necessary to run all of the refineries' present alkylation plants at capacity.

"There are many more refineries than there are alkylation plants," he said, "and should Government require only those refiners who have such alkylation plants to go to work on the problem the answer would be that these particular refineries could produce neither the quantity nor the necessary quality of automobile gasoline that is now required due to the technological progress and increased demand for gasoline that has followed World War II.

"The practical alternative to that impossible situation," Brown said, "has two parts. One is to ship charging stock from other refineries to help fill up the alkylation plants. The other is to squeeze down somewhat on the present super-quality of automobile gasoline.

"Should the military demand for avgas increase markedly the only answer will be to build still more special equipment to produce military avgas. The oil industry is willing to do this if assured of a market for the product and the end result should not be such as to affect seriously either the quantity or quality of gasoline available to civilians."

Pure Lab Opened

Public views company's new research facilities

CHICAGO.—Pure Oil Co. this week threw open to public inspection its completely new group of buildings housing its entire research and development department on a campus-like site in suburban Crystal Lake, Ill.

Noteworthy aspects of this were:

1. Unified housing of all of Pure's research on all phases of production, refining, transportation, and marketing in specially designed buildings with facilities for constructing special apparatus and equipment.

2. Location of the research department in a suburban community deliberately isolated from the company's offices and operating units.

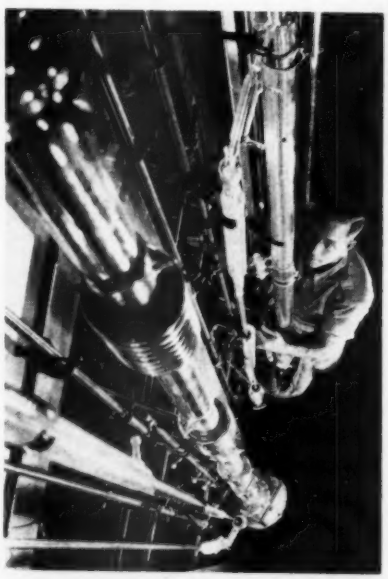
3. Invitation to all employes and their families and to all residents of the community to inspect the laboratories in operation, with guides, signs, and literature to explain the apparatus and procedures.

To consolidate its research work and increase the facilities, Pure purchased a site of 140 acres 45 miles from Chicago, and for 2 years has been building a group of five structures. More than 200 research employes have now been moved to Crystal Lake, and many of them are expected to build homes on the laboratory grounds. Although many oil companies prefer to have their research work located at refineries or producing fields, Pure is one of several which have deliberately secluded their research workers.

Location of a large oil installation in a small town brought many local protests because of a fear that the laboratories, with their testing engines and pilot plants, would be noisy, smelly, and dangerous. A public-relations campaign was conducted by Pure to offset this, climaxing in the week-end open house to which the entire community was invited.

Complete setup.—The five new buildings provide nearly 90,000 sq. ft. of working space, and include a boiler house, an extensive library, offices, machine shop, store rooms, engine test racks, a fleet of test cars, and separate laboratory sections for all phases of petroleum research from well cores and reservoir engineering to testing of lubricant additives and development of new petrochemicals. Much of the equipment was designed and built by company technicians. An entire building is devoted to pilot-plant studies of refining processes, and has one bay which can house columns 45 ft. high.

Dr. William B. Ross is head of Pure's research and development division, and Charles M. Ridgway is manager of the laboratories. Division heads at Crystal Lake are D. C. Bond, production and transportation; M. M. Marisic, product and process research; C. A. Porter, process development; B. L. MacKusick, office and plant; W. J. Backoff, product development; and R. J. Askevold, analytical research and service.



These three-story fractionating columns in operation at Pure Oil Co.'s new research and development laboratories at Crystal Lake, Ill., which were officially opened this week, are but a small portion of the many intricate apparatus which go to make up the testing center.

Avgas Supply Problem

Near-future demands can be met with existing facilities but long-range planning will call for refinery expansion

George Weber

WITH a green light from the Government, the current emergency involving a shortage of military aviation gasoline will be met by industry before the end of this year. This consensus of refiners reflects a firm optimism regarding the ability to fuel the military effort for the near future with facilities now at hand.

Refining leaders hasten to add, however, that no room for complacency exists in viewing the longer-range program of supplying substantially augmented military-fuel requirements. Plans are now very much in order for expanding refining operations across the board, with emphasis on more crude processing, catalytic cracking, catalytic reforming, and associated capacity to meet future civilian and military needs—war or no war.

Given a freedom of action allowing necessary intercompany cooperation in boosting aviation-gasoline production, the refining industry is fully confident that it can meet all military requirements for that No. 1 priority fuel. There exists today, sufficient capacity for filling all military avgas needs for the present and for the foreseeable near future.

Despite this, and despite almost unanimous cooperation of refiners with the Government, in individually augmenting avgas production, there remains an immediate problem of closing the gap of some 2,500,000 bbl. of avgas still needed to round out the military's estimate of requirements through December. This problem can be readily resolved, say refiners, when oil companies are granted legal permission to contact with one another for exchange of necessary alkylation feed stocks and gasoline components. While such legal protection is expected very shortly, every week's delay in paving the way compounds the problem of obtaining increased alkylate production over a shortening period.

The need for inter-company cooperation in producing more alkylate stems from the situation which existed during World War II when nearly all of the current alkylation plants were built. War economy demanded that steel, time, and manpower be saved by concentrating alkylation production in fewer larger plants strategically located in the principal refining areas. These plants were supplied with feed stocks by both the operating companies and neighboring refiners. The refineries in which most of these plants are located cannot provide the volume of feed stocks required to operate them at capacity. The pooling of such feed stocks and the requisite sharing of civilian gasoline components to prevent unequal advantage in competing for quality in the civilian market requires modification of the existing government attitude regarding such inter-company agreements.

Capacity high.—It is of interest to note that alkylation capacity in this country is roughly equal to that at the close of World War II. This fact refutes the impression in some circles that refiners allowed their alkylation potential to deteriorate by "junking and cannibalizing" war facilities. While it is true that some wartime alkylation units have been dismantled or converted to other uses, others have been expanded in capacity and a few new ones have been added since the war.

Four years ago there existed 59 alkylation units in the continental United States. They comprised 32 employing the sulfuric acid process and 27 using hydrofluoric acid as a catalyst. Their total rated capacity was for 178,000 bbl. of finished alkylate per day.

A survey conducted by The Oil and Gas Journal shows that a total of 44 alkylation units are now operating or are being readied for use in the near future. Of the 59 plants built during the war, 8 were dismantled, 5 were converted to other uses, and 5 remain as standbys which would require varying degrees of repair and equipment replacement before return to operation. The 44 plants, operating or operable, include two built since the war and a third now under construction. Of the total, 34 use the sulfuric acid process, accounting for over 80 per cent of rated capacity.

Expansion of existing facilities and addition of new plants resulted from a steady increase in aviation gasoline demand since 1946 plus the growing need for heavy alkylates to blend to motor gasoline in a fast-paced octane race. This summer, total alkylation production was estimated to amount to about 100 000 bbl. per day. Of that production, the equivalent of about 20,000 bbl. per day of aviation grade alkylate was going into motor gasoline.

Early estimates of higher military aviation gasoline needs arising from the Korean war were met by diverting suitable alkylates from motor to aviation stocks. At present, very little alkylate of a quality suitable for aviation gasoline is believed going to motor gasoline. The first and simplest step in boosting aviation-gasoline output—that of diverting high-octane components from motor to aviation stocks—is now essentially completed. There remains the dual need for revamping operations with more selective feed stocks to increase product quality, and for diverting more of such feed stocks to alkylation from outside sources.

Feed stocks of the required quality and quantity are available in the industry. The record expansion in catalytic cracking has substantially increased production of isobutane and butylenes since the war. The present problem involves their segregation and diversion to aviation alkylate production.

Qualifications. — Procurement of the necessary feed stocks for use in existing alkylation plants will take care of the present aviation-gasoline shortage. However, should solution of allocation problems provide for operation of all alkylation units at capacity, the industry's capability for aviation-gasoline output will still be far short of that reached during the last war. This is true mainly because of the increase in quality of present aviation gasolines.

During World War II combat and most overseas transport requirements were met adequately with the 100/130 grade product. Domestic military operations and commercial airlines used a gasoline of about 91 octane number. The postwar improvement in aviation engines has greatly increased gasoline-quality requirements.

Today, the combat grade is 115/145 and domestic demand, both military and commercial, is for the former combat grade of 100/130. Normally, 115/145 grade requires twice as much alkylate per barrel as the lower grade. But due to the critical shortage of aromatic blending stocks, the higher grade is today taking nearly three times as much alkylate. Some blends of 115/145 aviation gasoline now contain 85 per cent alkylate, as compared with an average of 30 per cent in the former combat grade of 100/-130. The lack of sufficient aromatic blending agents which are so important in obtaining the 145-octane rich-mixture rating has necessitated increasing alkylate from an average 70 per cent to the 85 per cent content, resulting in an accompanying but unnecessary lean-mixture rating increase to about 125 octane in some cases.

The increased quantity of alkylate required in modern military avgas, is accompanied by a required improvement in alkylate quality. This nar-

rows the field of permissible olefin feed stocks essentially to butylenes and imposes more exacting operation conditions for alkylation units, particularly of the HF type; all of which results in an effective reduction in alkylate producing capacity.

Thus, even though today's alkylation capacity is rated equal to that at the close of the war, its potential for producing higher-quality aviation gasoline must be rated at considerably less. While considered adequate to provide the military requirements of the foreseeable future, this capacity will undoubtedly require further expansion in preparation for the increasingly higher military requirements to be expected over a long period.

Technical improvements in alkylation processes will probably contribute to some expansion, as will bottleneck removals in existing plants. Still more capacity can be added with relative speed and lower material requirements, by adding to existing plants. Some new plants are also included in a long-range program.

Future shortages.—While alkylate represents today's prime requisite, it is expected soon to yield first place on the "wanted" list to another necessary component of a balanced aviation gasoline—the aromatics. All aromatic chemicals, particularly basic benzene, have for a year or more been in short supply. To the present excessive demand for such civilian commodities as detergents, synthetic fibers, and plastics is now added a critical requirement for reactivated operation of plants making synthetic rubber, explosives, and other war-essential chemicals.

Since the major source of basic aromatics, the coal-coking industry, shows no promise of increasing production rapidly, it appears to be up to the petroleum industry to concentrate on those processes yielding products of high aromatic content, and devolop its own sources of benzene, toluene, xylene, cumene, and other components necessary for a well-balanced aviation gasoline.

One barrel of high-quality aromatic blending agent will increase the production of 115/145-grade aviation gasoline by about 3 bbl. The availability of suitable aromatic stocks will reduce the required percentage of alkylate in present 115/145-grade avgas, in effect stretching avgas capacity as regards alkylate production.

Certain of the catalytic cracking processes yield a high percentage of aromatics, and postwar expansion of catalytic cracking capacity will make available more aromatics if proper extraction facilities are made available. The greatest promise for expanding aromatic production, however, comes from the catalytic reforming processes which are excellent sources of aromatic concentrates and pure aromatics. Currently, a number of new catalytic reforming units are under construction. This building program, prompted by the recent need for higher octane gasoline, is expected to be given added impetus by the aggravated emergency requirements for aromatics. In addition to the techniques now in use in the industry, two new catalytic reforming processes will be introduced this fall, focusing further attention to this important source of aromatics.

New plants seen.—Without the long-range planning which has now been undertaken by industry representatives cooperating with government agencies, the next few years would bring a continual succession of shortages in various fuel components. Anticipating these future needs and acting now to offset them will assure the industry's ability to supply both civilian needs and a superimposed military demand. The mildest prospect, continuation of a gradual build-up in military demand short of actual war, calls for a new round of refinery construction, from crude units to alkylation plants. Catalytic cracking and catalytic reforming, reflecting increased demand for both civilian and military production, should lead the list of new plants installed over the next few years.

SOUTHWEST

Oil-Conservation Job

Texas Commission will try to bring about application of secondary recovery in individual oil fields, Murray says

Joseph A. Kornfeld

HOUSTON.—The Railroad Commission of Texas will attempt to bring about the application of secondary recovery operations in individual oil fields where reservoir conditions require it, W. J. Murray, Jr., commission chairman, said here last week.

"We will do a job in oil conservation much as we have in gas conservation," he said. "We have the same challenge."

In an address before the Houston production chapter of American Petroleum Institute, Murray said that the commission has never issued an order requiring gas injection in an oil field to increase oil recovery.

However, he reasoned that, "if we have the power to shut in an oil field to conserve casing-head gas, we should have the power to require steps to increase oil recovery."

"There will be no exercise of coercion if continued progress is evident," he said, referring to proposed voluntary efforts by companies to use secondary recovery operations to correct excessive pressure and production declines.

The new role of the commission is indicated in its action towards the Diamond M field in Scurry County, West Texas, which produces from the Pennsylvanian Canyon Reef limestone.

A commission study of reservoir behavior covering the Scurry reef-trend fields from April 1 to September 1, indicated that bottom-hole pressure in the Diamond M field fell off 509 psi. during that period, or about 3 psi. per day. Last month, the commission commented that "these declines may be excessive" as it cut the top allowable from 220 to 160 bbl. per day for Diamond M as well as for Sharon Ridge and Kelly-Snyder fields. The rapid pressure decline was also reflected at Sharon Ridge which lost 318 psi. and Kelly-Snyder, where pressures fell off 407 psi. during the same period surveyed.

In an attempt to formulate a program to arrest the excessive pressure decline at Diamond M field, an informal conference was held at Midland on September 12 between representatives of the commission and the field operators concerned. Geological and engineering committees were

REEF ROCK.—A core taken of the Canyon reef, principal oil pay in the Scurry County, Texas, fields, is examined by Jay Mengle, Snyder, geologist in the West Texas district of Pan American Production Co.

formed to analyze the problem. It is believed that a water-injection pilot program will be recommended. A formal hearing will be held about the middle of October to consider the recommendations of these committees, Murray said.

Water injection.—The tentative plan contemplates producing water from a deep Ellenburger limestone well in the southwest corner of the field and injecting into a presently producing Canyon Reef oil well. The oil allowable would be transferred to other wells on the same lease. Bottom-hole pressures would be measured periodically at nearby wells to observe the effect of pilot-water injection on the rate of pressure decline in the Canyon Reef. If this project proves successful engineeringwise, proposals may be forthcoming from Diamond M operators to the commission to expand the program.

The commission chairman paid tribute to the gas conservation achievements of the Texas oil industry, explaining that the oil industry has done "an excellent job" along these lines and that it has been accomplished with a minimum of regulation.

Amplifying his comments on Texas efforts in gas conservation, Murray estimated that during September 1950 there were utilized about 3,000,000,000 cu. ft. of casing-head gas per day from 60,000 oil wells. During July 1950, the last official data available, there were utilized 2,700,000,000 cu. ft. of casing-head gas per day.

"Less than 2 per cent of the gas processed in Texas plants during September 1950 were flared," he said, an achievement which he termed "a tribute to voluntary conservation efforts."

He contrasted this current status with conditions operative during 1945 in Texas when only about 1,000,000,000 cu. ft. of gas a day was processed. Then as much as 30 per cent of the processed volume was vented to the air.

Permian Oil Show

Variety of equipment to be exhibited at Odessa

ODESSA.—More than 200 exhibitors have purchased indoor and outdoor space to display a wide variety of oil equipment at the Permian Basin Oil Show to be held here October 19-22. Space sales have accounted for more than $15,000 and represents manufacturers and service companies from 18 states.

The exhibit area includes four large buildings, one of them temporary, and thousands of square feet of outdoor space. The exhibits themselves will range from heavy perforating and cementing units to the small valves, fittings, and tools that are found everywhere in oil-field use. The latest in nearly every variety of equipment used in the oil industry will be on display.

The show has been designated "The oil-field workers' show" and this theme has influenced all planning. The 4-day affair is designed to show Permian basin citizenry how the oil-field worker lives, how he works, and what he works with; and to show members of the industry itself how other members of the industry work and the tools they use.

The "workers" theme has been further carried out in scheduling the show, since the dates selected coincide with Oil Progress Week, the 7 days when the oil industry, through American Petroleum Institute's Oil Industry Information Committee, tells the public about itself. Admission to all of the exhibit areas will be free.

In addition to the equipment exhibits, there will be several of the educational variety. Among these exhibitors are American Petroleum Institute, West Texas Geological Society, University of Texas Extension Division, American Association of Oilwell Drilling Contractors, U. S. Bureau of Mines, and National Safety Council.

Officers of the show's board of directors include Lloyd French, French Tool & Supply Co., Odessa, president; Early N. Spiars, Diamond Oil Well Drilling Co., Midland, vice president; Roy E. Carter, Amon G. Carter Foundation, Kermit, treasurer; and Houston Crump, Odessa Chamber of Commerce, secretary-director. H. E. Chiles, Jr., president of the Western Co., Midland, is chairman of an entertainment-ticket sales committee.

MEETINGS

Reserve Figures Revised

Future recoverable natural gas in U. S. will exceed 500 trillion cubic feet, Terry tells A.G.A. members

George Weber

ATLANTIC CITY.—The future recoverable natural gas in this country will exceed 500 trillion cubic feet, members of the American Gas Association were told here this week as they met for their thirty-second annual convention and exhibition.

In a joint session of the natural-gas and manufactured-gas departments held October 2, Lyon F. Terry, vice president of Chase National Bank, New York, presented a revised estimate of this country's proved and potential reserves of natural gas.

Citing the most recent report of the A.G.A. Committee on Natural Gas Reserves which estimated proved reserves of 180 trillion cubic feet as of December 31, 1949, Terry stated that at first glance, the present and projected annual consumption of natural gas would leave some question as to whether the presently proved reserves are sufficient to justify the newly proposed pipe lines. While present production is estimated at 6.25 trillion cubic feet annually, he placed yearly withdrawals on the order of 10 trillion cubic feet per year by 1960 in view of the vast expansion of natural-gas transmission systems.

The ability of the petroleum industry to supply natural gas to the greatly expanded consuming market was strongly indicated in his survey of potential gas reserves as compared with presently proved reserves. "There are reasons for believing," said Terry, "that of the hydrocarbons to be discovered in the future, the ratio of gas to oil will be higher than has occurred to date." As a principal reason for this hypothesis, he pointed to the Gulf Coastal plain and the adjacent tidelands area, where future discoveries at greater depths will contain higher proportions of free gas.

Older and deeper deposits tend toward lighter specific gravity and comprise larger percentages of lighter constituents. One explanation of this phenomenon states that contact of the original heavy bitumens with the natural catalysts of the retaining rocks promotes the progressive change toward lighter composition. Hence, it is likely, he concluded, that the future discoveries in the coastal and offshore areas at greater depths will contain higher proportions of free gas, since the deeper the deposit, the higher the reservoir temperature and the greater the possibility for more complete transformation of the original oil in place with resulting increased formation of gas.

It is now estimated that the Gulf tidelands will ultimately produce over 50 trillion cubic feet of gas. Summarizing, he gave the following reserve estimates in trillions of cubic feet; present proved reserves, 180; future discoveries on land, 280; future tidelands discoveries, 50; total future supply, 510.

Corrosion reports.—Among the numerous topics discussed in operating sessions of the week-long meeting, corrosion came up for considerable attention. R. B. Wilson, Mississippi Power & Light Co., Jackson, stated management's attitude toward a corrosion-control program as reflected

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by experience in his company. In his judgment, based on cost and results of a corrosion-control and cathodic-protection program, he stated that such measures do work, and should be regarded favorably by management.

Wilson cited some cathodic-protection costs, based on their experience last year. Including salaries and expenses of corrosion personnel, costs of material, time, transportation, and miscellaneous expenses chargeable to cathodic protection, and cost of electric power to operate cathodic-protection rectifiers during the year, he arrived at an average annual unit cost of approximately $21 per mile of 3-in. equivalent main under protection. While the cost balance is well on the credit side, he stated that actual savings incurred through cathodic protection are difficult to estimate.

In his report of the Corrosion Committee, Chairman Sidney E. Trouard of New Orleans Public Service, Inc., stated that competent estimates place the annual toll of corrosion to oil and gas lines in the United States alone at $600,000,000. Efforts of the committee for the past 2 years, he stated, have been directed principally to bringing to the attention of management of gas companies the seriousness of the corrosion problem. Mitigation of the enormous losses estimated due to corrosion of pipe lines can be brought about by properly designed and maintained cathodic protection. As an additional reduction in cost, he stated that because of corrosion, many pipe lines are overdesigned in wall thickness and that thinner wall pipes, properly protected, can be used advantageously with large savings in capital outlay and attending conservation of steel.

Further research on the subject is anticipated by the committee, but the immediate problem seems to be one of education, as it appears very evident that a goodly portion of the gas industry is not even now making use of corrosion research completed and perfected years ago, said Trouard.

G. A. MITCHELL

D. A. HULCY

D. A. Hulcy, president of Lone Star Gas Co., Dallas, was elected A.G.A. president. Other officers named include: George F. Mitchell, president of Peoples Gas Light & Coke Co., Chicago, first vice president; Charles E. Bennett, president of Manufacturers Light & Heat Co., Pittsburgh, second vice president; and Edward J. Barrett, president of Long Island Lighting Co., Mineola, N. Y., treasurer. Bennett also was elected chairman of the natural-gas department, succeeding Hulcy.

Drillers to Meet

Tulsa site of 10th annual A.A.O.D.C. convention

TULSA.—The American Association of Oilwell Drilling Contractors, which will hold its tenth annual meeting at the Mayo Hotel here October 8-10, predicts that this year's gathering will be one of the largest on record.

Many papers of importance to the drilling phase of the petroleum industry have been prepared, and special speakers have been engaged.

Dr. Waldo Stephens, vice president of Stephens Petroleum Co., Oklahoma City, will address the group at its annual banquet October 10. This is

FRANK PORTER

W. S. CHURCHILL

the second time that Stephens has appeared before A.A.O.D.C. during a national meeting.

Warren S. Churchill, Arrow Drilling Co., Dallas, A.A.O.D.C. president, will deliver the address at the first general session, to be held October 9. Guest speaker for this session will be Frank M. Porter, president of the American Petroleum Institute, New York City.

Among technical papers which will be presented during the general sessions of the 3-day meeting. are:

"Care and Maintenance of Slush Pumps," William J. Redman, Wilson-Snyder Division, Oil Well Supply Co., Braddock, Pa.; "Analysis of Surface Casing Failures," B. B. Smith, Loffland Brothers Co., Tulsa; "Effect of Oil Emulsion Mud on Drilling," Orien Van Dyke, Magnet Cove Barium Corp., and J. P. Weichert, Gulf Oil Corp., Houston.

"Causes and Prevention of Drill Collar Failure," Stanley C. Moore, Drill Collar Service Co., Midland, Tex.; "Drill Pipe Fishing With String Shot," T. C. Smith and Jack Chadderdon, Houston Oilfield Material Co., Houston.

"Drilling Research," Dr. J. V. Pennington, Drilling Research, Inc., Houston; "What Is Expected of the Oil Industry in the Event of a Major War Effort," Lt. Col. Wilson A. Chapman, U.S.A.F.; "Supervisory Training in the Oilwell Drilling Industry," A. L. Franzolino, Southern Methodist University, Dallas.

"More Hole for Your Money," C. W. Seibel, U. S. Department of Interior; "The Happy Combination," Jules E. Toussaint, producing department of Standard Oil Co. of California.

N.A.C.E. Symposiums

HOUSTON.—Two symposiums on pipe-line and production corrosion will be held concurrently during the 1950 South-Central Regional Meeting of the National Association of Corrosion Engineers, to be held here October 9 and 10.

More than 300 corrosion engineers from Texas, Louisiana, Oklahoma, Arkansas, Kansas, Colorado, and New Mexico are expected to attend the sessions to be held at the Rice Hotel, according to L. F. Scherer, Houston, chief engineer of Texas Pipe Line Co. and general chairman of the meeting.

The six sessions will be composed of 16 formal papers, four reports of field and laboratory evidence of bimetallic corrosion in petroleum production, two discussions, and an open forum.

Several of the technical-practices committees of the national group have scheduled meetings to be held during the regional conference including the committees on corrosion of oil and gas-well equipment, anodes for use with impressed currents, and internal corrosion of facilities for the storage and transportation of petroleum.

Topics to be discussed at the pipeline sessions deal with preparation of metals for coating, developments in anticorrosive coatings, experiences in applying various combinations of pipe-line coatings, the effect of pipe-diameter expansion on coating, corrosion of underground lead-sheathed power and telephone cables, and corrosion problems in salt-water operations.

A.P.I. Program Readied

LOS ANGELES.—The program for the thirteenth annual meeting of American Petroleum Institute, which will be held here November 13-16, was rapidly rounding into final form this week, and virtually all plans are now made with the exception of the naming of several speakers for various group sessions.

Three thousand or more oil and gas men throughout the country are expected to attend the meeting, which will be the first held on the West Coast since 1941. It will open formally November 13 with a group session on accident prevention, which will include a panel discussion.

Committee sessions, numbering nearly 100, will begin November 9 in advance of formal opening of the gathering. The first A.P.I. banquet since 1941 will be held November 15. Presentation of the A.P.I. Gold Medal for Distinguished Achievement is scheduled to be made Wednesday morning, November 15, to an as yet unidentified recipient.

INTERNATIONAL

Tanker Charters Rise

High level of activity in oil industry indicated by big increase in spot tanker charters throughout world

FURTHER evidence of the current high level of activity in the petroleum industry is furnished by the approximately 100 per cent rise in spot tanker charters over the last 3 months.

In June open-market charters for single voyages were being made at 65 per cent of the old wartime U. S. Maritime Commission rates which are still being used as a base. Last week, chartering rates had climbed to 125 per cent of U.S.M.C., and the outlook was for still higher fixtures.

The tanker-chartering market in general provides a sensitive barometer to conditions in the petroleum industry. In addition, charter rates are important in the industry in that they are a factor in the laid-down costs of oil in many marketing areas.

While tanker charters influence the market in products along the East Coast of the United States, they are of considerably greater importance in Europe and other foreign areas. Many of these countries depend wholly for their oil supply on tanker hauls over great distances from such producing centers as the Caribbean or the Persian Gulf.

Along the East Coast last week, the upsurge in tanker rates was one of the several factors contributing to a general tightening of the products market, particularly in heavy oils. The recent rise in chartering rates has been so sharp that its effect on delivered price has become appreciable.

For example, the old U.S.M.C. rate for shipments from the Gulf Coast to the United States East Coast north of Hatteras was $2.85 a long ton. Under the 35 per cent below U.S.M.C. chartering rate that prevailed early in the summer, 20°-gravity oil could be moved to New York for 27 cents a barrel. At present, the cost of this movement, at 25 per cent above U.S.M.C., would be nearly 52 cents a barrel.

The relationship of tanker charter rates on the products market is not as direct as these figures would indicate. By far the greater amount of oil, crude and products, is hauled in company-owned vessels or those which the companies have under long-term charters. The companies fill out their marginal tonnage requirements in the spot charter market, but it has been estimated that 10 per cent or less of the total United States coastal oil movement is in vessels chartered on the spot market.

However, a large part of the spot-market trading in petroleum products depends on these open-market tanker charters. Thus, the open charter market affects the spot market in products which usually leads the way in general price changes.

Several factors. — A combination of factors is given as the cause of the recent upward climb in open-market tanker rates. To some extent it is seasonal. Preparations for winter consumption of heating and burning oils usually result in some advance in spot tanker rates in later summer and early fall.

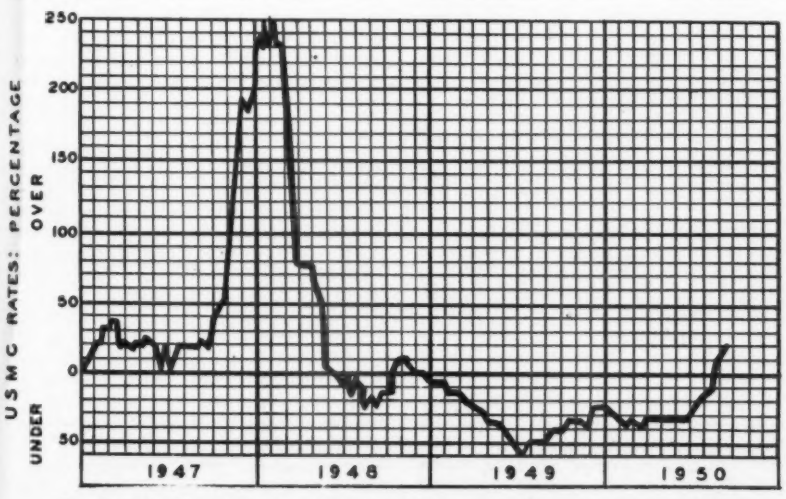
In addition to this is the present record high level of industry activity world wide. Production is at an all-time peak, and demand for oil appears to have been increasing at an unanticipated rate. This has brought a number of suppliers into the tanker market seeking vessels to meet these extra requirements.

As far as is known, direct demands of the military are not at present a significant factor in the tanker market. However, some officials feel that a certain amount of stockpiling of oil by some foreign countries is contributing to the demand for tankers. There have been reports that Italy, Argentina, and Brazil, as well as other countries, are attempting to bring their storage to a maximum.

To continue upward.—Indications are that spot chartering rates will continue to move upward for at least several more weeks considering the present demand for tankers. What will happen later this fall is obscure. If the Korean fighting ends and war fears subside, the market could drop off as quickly as it rose. Furthermore, another bearish factor is the opening of the Trans-Arabian pipe line in 3 or 4 months. Depending on the rate at which it operates, this line will release up to 60 or more tankers.

The following gives the cost, in cents per barrel, of moving 20°-gravity oil between selected points under spot tanker rates and those prevailing early in the summer:

	U.S.M.C. plus 25%	U.S.M.C. minus 35%
Venezuela to U. K.	119	62
Venezuela to New York	51	28
Persian Gulf to U. K.	199	103
Persian Gulf to New York	2.31	1.20
Aruba to Buenos Aires	1.31	68



Trend of single-voyage charter rates on the open market since January 1947.

MIDDLE EAST

Last Tapline Joint Welded

The last joint of pipe for Trans-Arabian Pipe Line Co.'s 1,068-mile line was laid and the final weld made September 25, according to B. E. Hull, president.

Joining of the two sections of 30 and 31-in. pipe laid from the east and west now makes the line continuous from the Persian Gulf area to the Mediterranean Sea. Conclusion of this spectacular pipe-laying undertaking occurred well ahead of the October 1 scheduled completion date.

International Bechtel, Inc., completed laying and welding of the eastern section on September 14 to a point near the Turaif pump station in Saudi Arabia in the vicinity of the boundary between Trans-Jordan and Saudi Arabia. There the western section, laid by Williams Brothers Overseas Co., was completed by the so-called "golden weld" last week.

XUM

In New Job

White is executive vice president of Imperial

JOHN R. WHITE, whose appointment as executive vice president of Imperial Oil, Ltd., was announced recently, has assumed his new duties, succeeding H. H. Hewetson.

A native of London, Ont., Canada, White graduated from the University of Toronto in 1931 with a B.S. degree in mechanical engineering.

Joining Imperial in 1933 as a draftsman and engineer in the Sarnia, Ont., refinery, he went to the United States in 1937 for special studies in manufacturing coordination. The following year he joined Standard Oil Co. of Venezuela (later a part of Creole Petroleum Corp.) and became its vice president in 1942.

He returned to the United States in 1944 and was engaged in producing work in an administrative capacity before rejoining Imperial in the same year as economic coordinator.

Elected a director in April 1945, White was appointed vice president of the firm in October 1945.

Fletcher F. Farrar, formerly petroleum engineer with The Texas Co. at Salem, Ill., has joined Joe Slivka & Son, independent operators at Mount Vernon, Ill., as general superintendent in charge of field operations.

John Blixt, district geologist with The Texas Co., at Casper, Wyo., has been given a special 6 months assignment in Australia. **E. L. Beaman,** assistant district geologist, will handle activities in the Wyoming district during Blixt's absence.

J. E. Orrell, chief mechanical engineer in the production department for Shell Oil Co., Tulsa, has been transferred to the regional staff at Houston. Other changes include: **J. D. Goodrich,** transferred from Houston to Tulsa, replacing Orrell; **J. M. Maxwell,** area geologist, transferred from Tulsa to Houston; **D. M. Vander Stoep,** geophysicist division at Oklahoma City, transferred to seismologist of Geophysical Party 54 in the Denver district; **W. C. Gussow,** geologist at Oklahoma City, moved to the Tulsa area office; **W. M. Booth, Jr.,** transferred from Houston to Tulsa as drilling engineer; **M. M. Durham,** transferred from Oklahoma City to North Texas division and named division production geologist; **J. R. Fraser,** transferred from Wichita Falls to the Oklahoma division as production geologist; and **H. B. Carlile, Jr.,** transferred to Tulsa from Houston and named gas engineer in the gas department.

Charles R. Olson, graduate student of Texas A. & M. College, has joined Ohio Oil Co. as petroleum engineer.

R. B. Sale, formerly assistant regional manager of Continental Oil Co.'s production department, at Ponca City, Okla., has been named to the newly created position of director of training in the production department there. He joined Continental as a clerk in 1926, was named manager of production in 1943, and assistant region manager in 1949.

D. W. Reeves, general sales manager of the Oklahoma Natural Gas Co., has resigned to join Public Service Co. of New Mexico at Albuquerque where he will resume the duties of executive vice president. Reeves is president of the Oklahoma Utilities Association, and chairman of the industrial and commercial gas section, American Gas Association.

Merle Becker, formerly executive vice president of W. C. McBride, Inc., St. Louis, and **J. P. Sloss,** formerly manager of the San Antonio office of the same firm, have resigned to form an independent oil firm with headquarters in San Antonio.

F. M. Ricks, assistant to the president, Southland Royalty Co., has been appointed vice president of the Fort Worth Geological Society. Ricks will serve the unexpired term of **H. Boyd Baxter,** Continental Oil Co., transferred on temporary assignment to Houston.

Norton E. Fincher, operator in charge of subsurface measurements for Humble Oil & Refining Co. at New Orleans, has been transferred to Paradis, La., as assistant district petroleum engineer.

Charles R. Perkins, formerly manager of Sun Oil Co.'s central production division, Evansville, Ind., has been transferred to Dallas as secretary-treasurer of Mid-Valley Pipeline Co.

F. L. Addicks, driller for Carper Drilling Co. at Hobbs, N. M., has been transferred to Roswell, N. M., as tool pusher.

William T. Uzzell, Jr., research engineer for Phillips Petroleum Co., Bartlesville, Okla., has been transferred to Fairfax, Okla., as petroleum engineer.

Kenneth L. Black, engineer in the Wewoka, Okla., district for Interstate Oil Pipe Line Co., is now located at the Wilson office in southern Oklahoma in the same capacity.

Hugh D. Sheffield has joined Atlantic Refining Co. at Dallas as a petroleum engineer.

G. Montgomery Mitchell, petroleum engineer for Continental Oil Co., has been transferred from Ponca City, Okla., to the Panhandle district at Borger, Tex., in the same capacity.

L. B. Culligan, of the exploration development and geological staff of The California Co. at New Orleans, has been transferred to the production department of the Mid-Continent division at Ardmore, Okla. Other changes include: **L. F. Adams,** exploration, eastern division, Williamsport, Pa., transferred as staff assistant to New Orleans; **E. N. Dunlap,** production-engineering staff at New Orleans, transferred to the Gulf Coast division at Barataria, La.; **H. D. Fox,** production, North Louisiana and Mississippi division, Natchez, Miss., transferred to exploration at Jackson, Miss., in charge of the Southern division, Mississippi district; **E. V. Harrison,** exploration, geophysics division, New Orleans, transferred to the Eastern division at Williamsport; **W. W. Heard, Jr.,** production, northern Louisiana and Mississippi division, Natchez, moved to the engineering staff at New Orleans; and **L. E. Scott,** exploration, land and lease division, New Orleans, transferred to the Eastern division at Williamsport.

PERSONALS

Rex E. Cheek, in charge of gas development and production for Stanolind Oil & Gas Co. at Ulysses, Kans., has been transferred to the West Edmond area, of Oklahoma, in charge of oil development and production.

John L. Cox, formerly with Stanolind Oil & Gas Co., has joined Ted Weiner and Associates, independent oil operators, as engineer for the West Texas division at Midland.

James T. Rasbury has joined Deep Rock Oil Corp., Tulsa, as manager of personnel and industrial relations, succeeding **J. H. Westbrook,** who has been transferred to the marketing division at Minneapolis.

Tom Keating, drilling-research engineer for Stanolind Oil & Gas Co., Houston, has been transferred to Tulsa in the same capacity.

H. W. Yeargain, tool pusher for Basin Drilling Co. at Snyder, Tex., has been transferred to Big Spring, Tex., in the same capacity.

O. E. Van Meter, Jr., reservoir engineer for Magnolia Petroleum Co. at Midland, Tex., has been granted a company fellowship for further studies at Texas A. & M. College.

Humberto Jose Penaloza, petroleum engineer for Creole Petroleum Corp., at La Salina, Venezuela, is now studying at the University of Tulsa.

Sidney H. Smith, Jr., formerly an independent oil operator at Harlingen, Tex., has joined Fish Construction, Inc., as line-testing engineer on the Transcontinental Gas Pipeline Co., Inc., construction project. **Ray M. Johnson,** construction superintendent for Fish at Okmulgee, Okla., has been transferred to gas-compressor-station construction work at Reidsville, N. C., on Transcontinental's line.

D. K. Davis, tool pusher for Penrod Drilling Co., Haynesville, La., has been transferred to Ruston, La., in the same capacity.

E. P. Heath, district superintendent for Sunray Oil Corp., Hutchinson, Kans., has been transferred from the Trapp district to the McPherson district at Hoisington, Kans., in the same capacity.

R. O. Canon, Odessa, Tex., has been reelected president of the Petroleum Marketers Association of Texas. Other officers elected include: **E. B. Chapman,** Sherman, first vice president; **L. B. Williams,** Marshall, second vice president; **Richard Hinkle,** Midland, reelected secretary - treasurer; and **W. E. Syers,** Austin, was retained as executive secretary.

Arthur A. Gall, district foreman for Manufacturers Light & Heat Co., has been named manager of the company's offices at Uniontown and Somerset, Pa. Other changes within subsidiaries of Columbia Gas System, Inc., include: **Kenneth E. Harsh,** district manager at Salem, Ohio, for Natural Gas Co. of West Virginia, named manager of offices in Salem, Leetonia, and Lisbon, Ohio; **Harold W. Loman,** chief clerk at Alliance, Ohio, for Natural Gas Co. of West Virginia, named to replace Harsh at Salem; **Albert E. Marx,** named district engineer in the distribution department at Pittsburgh for Manufacturers Light & Heat; and **John D. Ford,** named district engineer at Allentown, Pa., for Manufacturers' distribution department.

J. O. Hendricks, tool pusher for Lowell & Gist, Inc., at Casper, Wyo., has been transferred to Craig, Colo., as field superintendent.

C. E. Hannum, district geologist for The Texas Co. at Ardmore, Okla., has resigned to become a consulting geologist in that sector of Oklahoma. He has been with Texaco since 1937, and will be succeeded by **John Mayes,** geologist.

Jacob C. Groenewegen, Shell Oil Co., has been transferred to Shell Chemical Corp. at Torrance, Calif., as instrument repair foreman. Other changes include: **John A. Hatton,** senior technologist, transferred from the Wilmington, Calif., refinery, to New York; **Richard H. Tubman,** senior engineer, transferred from New York to Wilmington; and **Richard E. Van Ingen,** technologist, Wilmington, transferred to the head office in New York.

C. A. Cowan, district geologist; **C. A. Schwartz,** geologist; and **W. R. Shively,** district landman, were among the personnel of Union Oil Co. of California, who were transferred from Jackson, Miss., to New Orleans, recently as a result of the company's office transfer.

Harold Edwards, district geologist for Stanolind Oil & Gas Co., Wichita Falls, Tex., will soon be transferred to the firm's new district office at Abilene, Tex., in the same capacity.

Milton Crow, West Texas division superintendent for Pan American Pipe Line Co. at Snyder, and **V. T. Tracy,** North Texas division superintendent, Longview, Tex., have exchanged positions. Other changes include: **S. L.**

NOMADS VISITORS.—Above are foreign visitors who attended the recent Los Angeles Chapter of Nomads meeting. Front row, left to right: H. W. McPherson, Asiatic Petroleum Co., Venezuela; W. E. Childers, Mene Grande Oil Co.; A. F. Driskill and R. E. Lorenz, both with Iraq Petroleum Corp.; Shorty Long, Drilling & Exploration Co., Turkey; Ray S. Reed and Ted Kopp, both with Iraq Petroleum Corp.; and Herbert E. Ullred, Socony-Vacuum Oil Co. of Venezuela. Back row, left to right: Jesse Roberts and Vernon E. Clayton, both of Iraq Petroleum Corp.; W. R. Young, National Supply Export Corp., London; Jorge Pacheco, Fomento, Chile; Ben H. Fuchs and H. E. Johnston, both with Drilling & Exploration Co.; Cope Johnston, Servicio Thomas, Venezuela; and J. J. McClellan, Drilling & Exploration Co., Turkey.

XUM

PERSONALS

Surratt, division foreman, Longview, transferred to West Texas, where he will have jurisdiction over the Kelly-Snyder area; and **Lee May,** district foreman, Quitman, transferred to Longview replacing Surratt.

E. E. Boudinot, construction engineer for General Petroleum Corp., Los Angeles, has been selected to supervise the construction of a new oil refinery to be built by Vacuum Oil Co., Ltd., in Coryton, England.

J. R. Parten, president of Woodley Petroleum Co., Houston, has been appointed consultant on industrial mobilization by **Oscar L. Chapman,** Secretary of Interior.

J. P. Black has been named manager of the exploration department of American Republics Corp., Houston, and **Fravy E. Davis** has been named assistant manager. Both are newly created positions. Other changes include: **Sam E. Sims,** appointed coordinator of geology and geophysics; and **George R. Morgan,** assistant secretary and assistant treasurer of the corporation, named assistant to the president.

L. P. Carpenter, regional manager of production for Continental Oil Co., has been transferred from Ponca City, Okla., to the company's newly established central region headquarters in Oklahoma City. Others transferred to the new region include: **W. E. Landrum,** regional engineer, production; **E. C. Mannis,** regional superintendent of natural gasoline and gas division; **V. T. Lyons,** proration engineer; **Jack Marshall,** petroleum engineer; **G. C. Clark,** regional manager of exploration; **C. L. Arnett,** regional geologist; **John W. Cram,** superintendent of the land department; **Paul R. Warren,** regional geophysicist; and **M. B. Lay,** geophysical department. In addition to those transferred from Ponca City, transfers to Oklahoma City include: **W. C. Hawk,** assistant regional geologist, formerly of Houston; **Willis Dupuy,** regional landman, formerly of Shreveport; and **G. T. Pearson,** assistant regional production manager, formerly of Fort Worth.

William G. Heltzel, consulting pipeline engineer, has been on an inspection trip to steel mills during his visit to Germany in recent weeks.

S. N. Meltzer, member of a seismograph crew for Cities Service Oil Co. in New Mexico, has been transferred to Amarillo as a geological scout. He replaces **Roland Du Paul,** who has been transferred to the Midland, Tex., office.

Frank T. Page has been named manager of the New York export sales office of Phillips Chemical Co.'s fertilizer-sales division. A native of Pittsburgh, Pa., he became associated with Phillips in 1948 at Tulsa.

Al Wynn, geologist for Murphy Corp., El Dorado, Ark., is to head an office for the company at Calgary, Alta., Canada. He will be succeeded at El Dorado by **Todd Landis, Jr.**

Eudell Price, formerly with McCullough Tool Co. at New Iberia, has been named district landman at Shreveport for Crown Central Petroleum Co.

Cliff Bowles, formerly with Yegua Corp., Houston, has joined the geological staff of Commercial Petroleum & Transport Corp., Houston.

Gus E. Howell, tool pusher for Penrod Drilling Co., has been transferred from Colorado City, Tex., to Post, Tex., in the same capacity.

Kinman Thompson, petroleum engineer for Gulf Refining Co. at Kilgore, Tex., has been transferred to Lafayette, La., as assistant petroleum engineer.

Jack H. Sigmon, geological scout for Gulf Oil Corp. at Midland, Tex., has been transferred to Amarillo in the same capacity.

Harold D. Gibson, engineer for Esso Standard Oil Co., recently returned from Europe where he studied latest gas-turbine developments. Other Esso men returning from foreign assignments include: **Henry Ernst** and **Richard Wright, Jr.,** who completed a study of the power and refining facilities in the producing fields and refinery at Talara, Peru; **Wilson C. Rich, Jr.,** from Japan, where he assisted in initial operations of new acetone-benzol dewaxing facilities at Standard-Vacuum's Shimizu Refinery; and **Leo W. Schrader,** from Europe, where he reviewed Polish nationalization claims.

Jack Elliott, geological scout for The Texas Co., has been transferred from Roundup, Mont., to Casper, Wyo., in the same capacity.

James L. Tatum, independent geologist, has been elected president of the Four Corners Geological Society, an organization for the members of the American Association of Petroleum Geologists working in the four corners area of New Mexico, Colorado, Utah, and Arizona. Other officers include: **Joseph L. Borden,** district geologist for Pure Oil Co., vice president; and **Lee Graham,** geologist for Stanolind Oil & Gas Co., secretary-treasurer.

John P. Speer has been named supervisor of industrial relations for Sohio Petroleum Co., with headquarters in Oklahoma City. He was formerly assistant supervisor.

Harry F. Bennetts, executive secretary of the National Lubricating Grease Institute, has been elected a member of the board of directors of the American Trade Association Executives.

R. E. Minnis, district geologist for Phillips Petroleum Co. at Shawnee, Okla., has been transferred to Oklahoma City in the same capacity, and **W. E. McMurtry** has been transferred from Shawnee to Oklahoma City as assistant district geologist. Minnis succeeds **A. J. Montgomery** who has been transferred to Bartlesville, Okla., as division geologist.

Leland Thompson, formerly with Sunray Oil Corp.'s district geological and land department in Midland, Tex., has resigned and opened offices there as an independent.

DEATHS

David C. Proctor, 59, former attorney for Gulf Oil Corp., died September 24 in Fort Worth.

Winston P. Henry, 62, head of Putnam Oil Co., died September 26 at Houma, La.

Robert Lee Trail, 55, The Texas Co., died September 26 in Tulsa.

Kollock H. Cawthon, 49, attorney for Gulf Oil Corp., Houston, died September 24. He had been with the firm 23 years.

Fred S. Brown, 35, part-owner of Kilmarnock Oil Co., Mexia, Tex., died September 27.

Fred Clarence Hall, 66, former Oklahoma oil man, died September 27 in San Antonio.

Clarion George Cox, 68, retired district manager of the National Supply Co., died September 26 in Tulsa.

Annual Drilling Number

THIS section presents a variety of interesting and useful material on rotary-drilling operations, hitherto unavailable in a single package. Especial acknowledgment and credit for assistance go to certain companies, as follows:

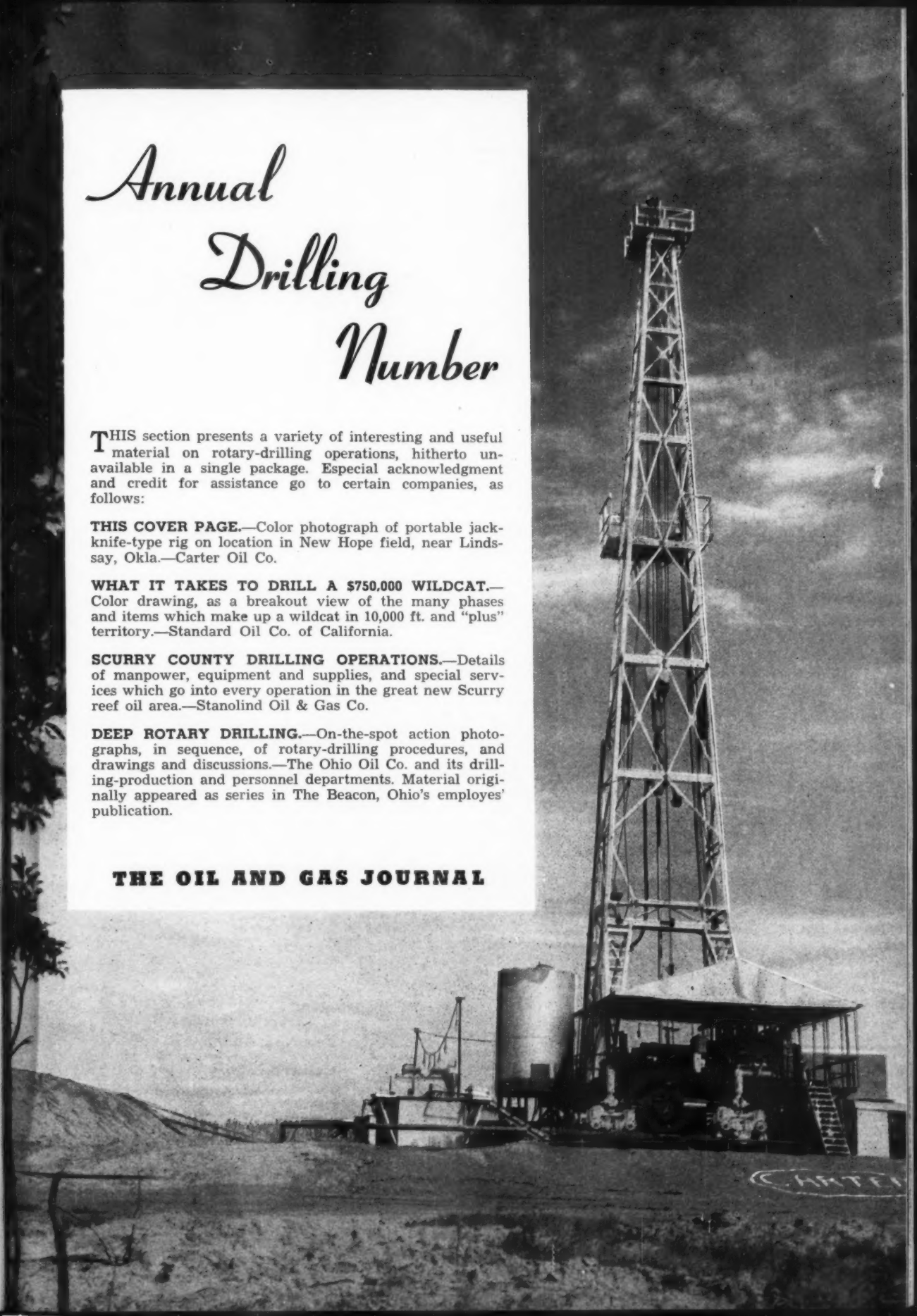
THIS COVER PAGE.—Color photograph of portable jackknife-type rig on location in New Hope field, near Lindsay, Okla.—Carter Oil Co.

WHAT IT TAKES TO DRILL A $750,000 WILDCAT.—Color drawing, as a breakout view of the many phases and items which make up a wildcat in 10,000 ft. and "plus" territory.—Standard Oil Co. of California.

SCURRY COUNTY DRILLING OPERATIONS.—Details of manpower, equipment and supplies, and special services which go into every operation in the great new Scurry reef oil area.—Stanolind Oil & Gas Co.

DEEP ROTARY DRILLING.—On-the-spot action photographs, in sequence, of rotary-drilling procedures, and drawings and discussions.—The Ohio Oil Co. and its drilling-production and personnel departments. Material originally appeared as series in The Beacon, Ohio's employes' publication.

THE OIL AND GAS JOURNAL



XUM

765 ROTARY-DRILLING CONTRACTING FIRMS RUNNING 1,977 RIGS . . throughout the United States

STATES OF HOME OFFICE LOCATION	NUMBER OF CONTRACTORS	NUMBER OF RIGS RUNNING THROUGHOUT U.S.A.	NUMBER OF SUPERINTENDENTS AND TOOL PUSHERS
TEXAS	353	891	764
LOUISIANA	43	125	126
OKLAHOMA	133	533	180
KANSAS	67	112	77
CALIFORNIA	55	110	89
ILLINOIS	51	77	130
OTHER	63	129	238

*Stabilized figure for census study; see discussion.

Census of Rotary Drilling Contractors

Rotary contract drilling is a million-dollar per day business. That figure of $1,000,000 per day, under current conditions of activity and present costs, is the gross worth of the footage cut by the rotary drilling industry in this country.

Rotary-drilling contractors have approximately $400,000,000 invested in drilling equipment and auxiliaries of all kinds. This figure includes the total capitalization, at present prices, of all drilling rigs, drill pipe, drilling tools of all kinds, and the large list of associated equipment which drilling contractors own, operate, and maintain with each rig or within their over-all businesses. There are approximately 3,000 rotary rigs available, of all types, for operation in the United States.

There are 38,319 employes in the rotary contract-drilling segment of the oil and gas industry. There are 765 rotary contracting companies.

THE above figures are some of the keynote data obtained by the Journal's "Census of Rotary Drilling Contracting Firms." A 6-month field study has just been completed by the Journal, to gather together this drilling census. A special field organization was created. The census representatives interviewed firms making up practically all of the rotary drilling industry, both as to larger and smaller contractors. Fullest cooperation was obtained, direct data were released by those operating 98 per cent of all rigs today.

Size of contractors.—Data showing rigs owned, and currently operated, by contractors of different size ranges are shown in the accompanying charts. Other "size" information of interest on drilling contractors follows:

Ten contractors.—One group of 10 very large contractors operates 14 per cent of all rigs running. These are: Kerr-McGee Oil Industries, Inc., Oklahoma City; George P. Livermore, Inc., Lubbock, Tex.; Loffland Brothers Co., Tulsa; Fred M. Manning, Inc., Denver; Noble Drilling Corp., Tulsa; Olson Drilling Co., Tulsa; Parker Drilling Co., Tulsa; Penrod Drilling Co., Shreveport; Rowan Drilling Co., Fort Worth; Warren & Bradshaw Drilling Co., Tulsa.

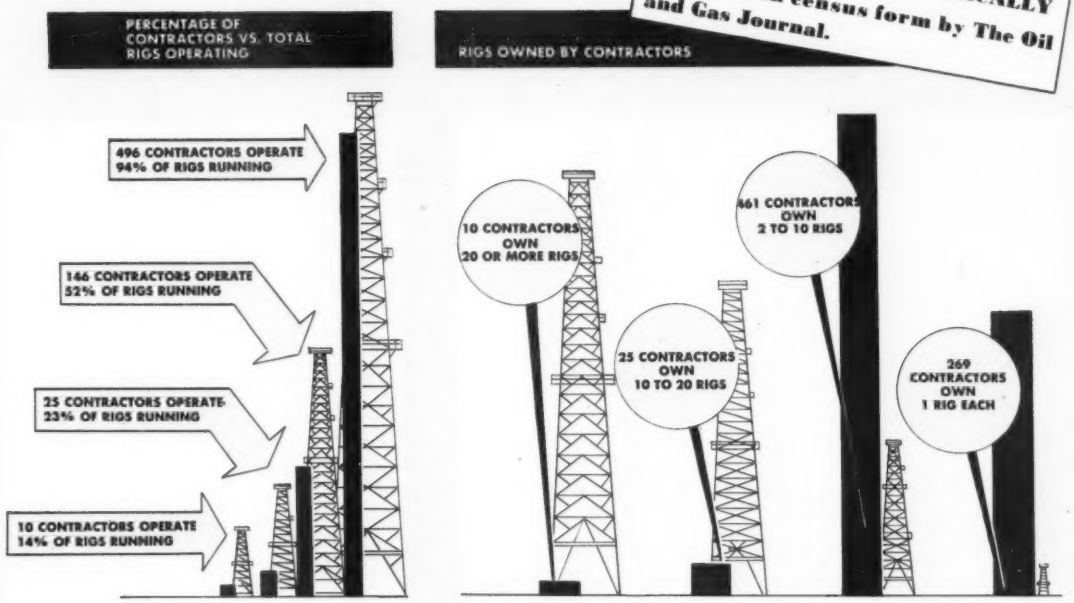
Twenty-five contractors.—A group of 25 large contractors operates 23 per cent of all rigs running. These contractors are: Arrow Drilling Co. and Arrow Drilling Co. of Texas, Tulsa; Big Chief Drilling Co., Oklahoma City; Danciger Oil & Refining Co., Fort Worth; M. J. Delaney Co., Dallas; Delta Drilling Co., Tyler, Tex.; Delta Gulf Drilling Co., Tyler, Tex.; Drilling & Exploration Co., Inc., Abilene; Falcon Seaboard Drilling Co., Tulsa; Gardner Brothers Drilling Co., Dallas; Harbar Drilling Co., Wichita; Helmerich & Payne, Inc., Tulsa; Kerr-McGee Oil Industries, Inc., Oklahoma City; Carl B. King Drilling Co., Midland; George P. Livermore, Inc., Lubbock; Loffland Brothers Co., Tulsa; Fred M. Manning, Inc., Denver; Noble Drilling Corp., Tulsa; Olson Drilling Co., Tulsa; Parker Drilling Co., Tulsa; Penrod Drilling Co., Shreveport; Rocky Mountain Drilling Co., Los Angeles; Rowan Drilling Co., Fort Worth; Two States Drilling Co., Dallas; Warren & Bradshaw Drilling Co., Tulsa; Wheless Drilling Co., Shreveport.

Large majority.—A group of 496 contractors operate 94

Here's the story of the rotary-drilling contracting business . . . .

- **NUMERICALLY**
- **OCCUPATIONALLY**
- **GEOGRAPHICALLY**

compiled in census form by The Oil and Gas Journal.


PERCENTAGE OF CONTRACTORS VS. TOTAL RIGS OPERATING
496 CONTRACTORS OPERATE 94% OF RIGS RUNNING
146 CONTRACTORS OPERATE 52% OF RIGS RUNNING
25 CONTRACTORS OPERATE 23% OF RIGS RUNNING
10 CONTRACTORS OPERATE 14% OF RIGS RUNNING
RIGS OWNED BY CONTRACTORS
10 CONTRACTORS OWN 20 OR MORE RIGS
25 CONTRACTORS OWN 10 TO 20 RIGS
461 CONTRACTORS OWN 2 TO 10 RIGS
269 CONTRACTORS OWN 1 RIG EACH

per cent of all rigs running. The difference between the total of 765 contractors and these 496 contractors, or the smaller one-third of the entire industry, as to size of individual firms, is represented entirely by one-rig owners.

Home office location.—The term "home office location" by no means indicates the scope of operational activity for most drilling firms. Rotary drilling is widespread and far flung, as to operating areas of all drilling companies. Home office location is where all business and accounting activities are centered; is a focal point for tool pushers and drilling superintendents' reports. Breakdowns as to specific cities are:

Cities of Home Office Location

OKLAHOMA

Tulsa.—60 contractors located here; 364 rigs in operation.

Oklahoma City.—36 contractors are domiciled; 97 rigs operating.

TEXAS

Wichita Falls.—97 contractors present; 123 rigs in operation.

Fort Worth-Dallas.—58 home offices of contractors; 226 rigs running.

Houston.—67 contractors have offices; 208 rigs in field use.

Midland-Odessa.—34 contractors present; 88 rigs in operation.

LOUISIANA

Shreveport.—29 contractors have home offices; 91 rigs running.

KANSAS

Wichita.—Home office for 48 contractors; 82 rigs in operation.

CALIFORNIA

Los Angeles-Long Beach.—Headquarters for 29 drilling contractors; 90 rigs running for these firms.

Tool Pushers

Tool pushers are the "ramrods" on personnel "mainstays" for efficient rig operations. They are the field bosses, in direct charge of the rigs. Drilling contractors regard their tool pusher's services as invaluable. Here are numerical and geographic data as to drilling superintendents and tool pushers for 1,977* operating rigs:

West Texas: 513 tool pushers, or 31.3 per cent of total; **Texas Gulf Coast:** 251 tool pushers, 15.2 per cent; **Louisiana Gulf Coast:** 126 tool pushers, 7.8 per cent; **Oklahoma:** 180 tool pushers, 11.2 per cent; **Kansas:** 77 tool pushers, 4.8 per cent; **Rocky Mountain area:** 61 tool pushers, 3.8 per cent; **California:** 89 active tool pushers, 5.5 per cent.

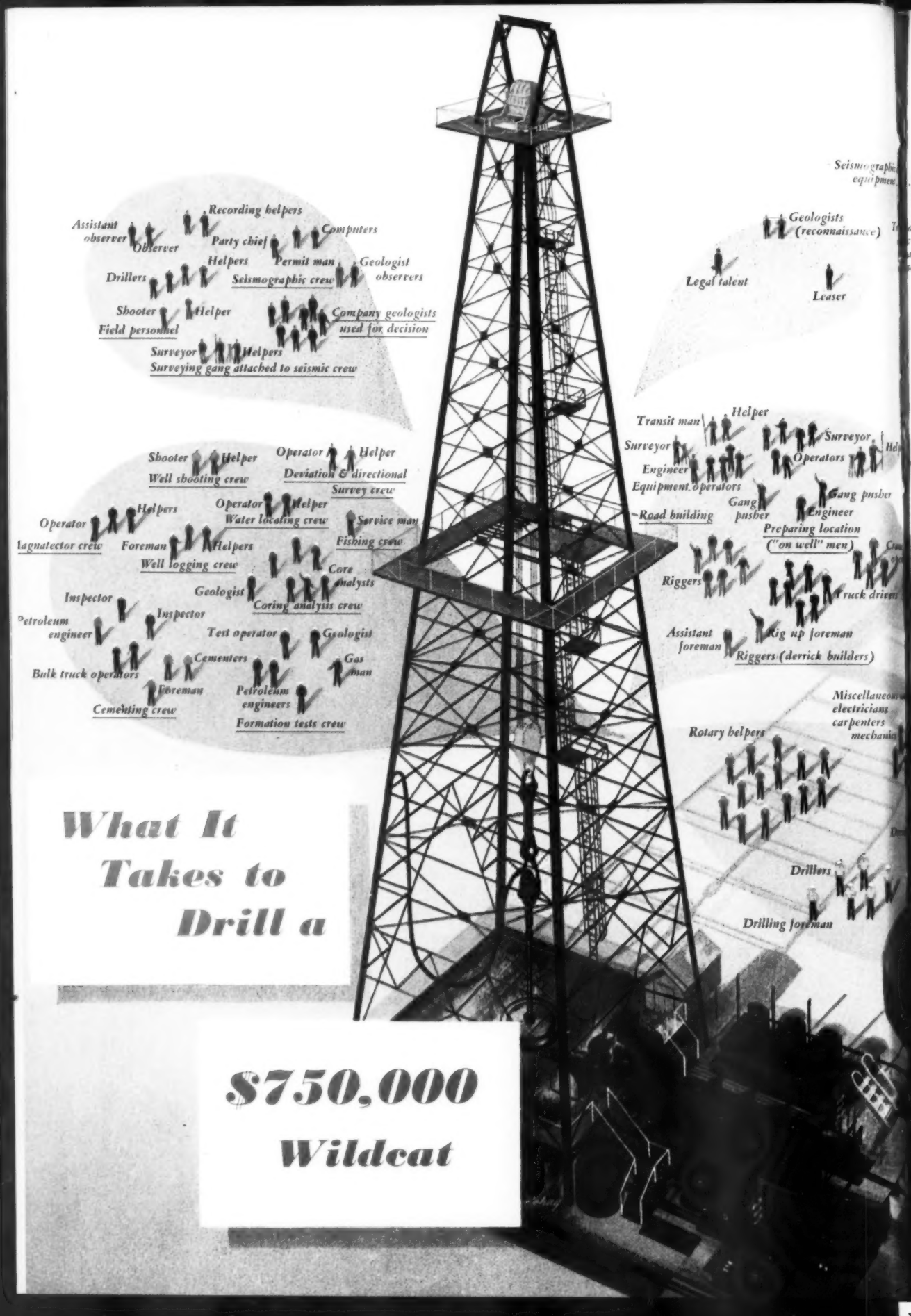
Drilling Equipment

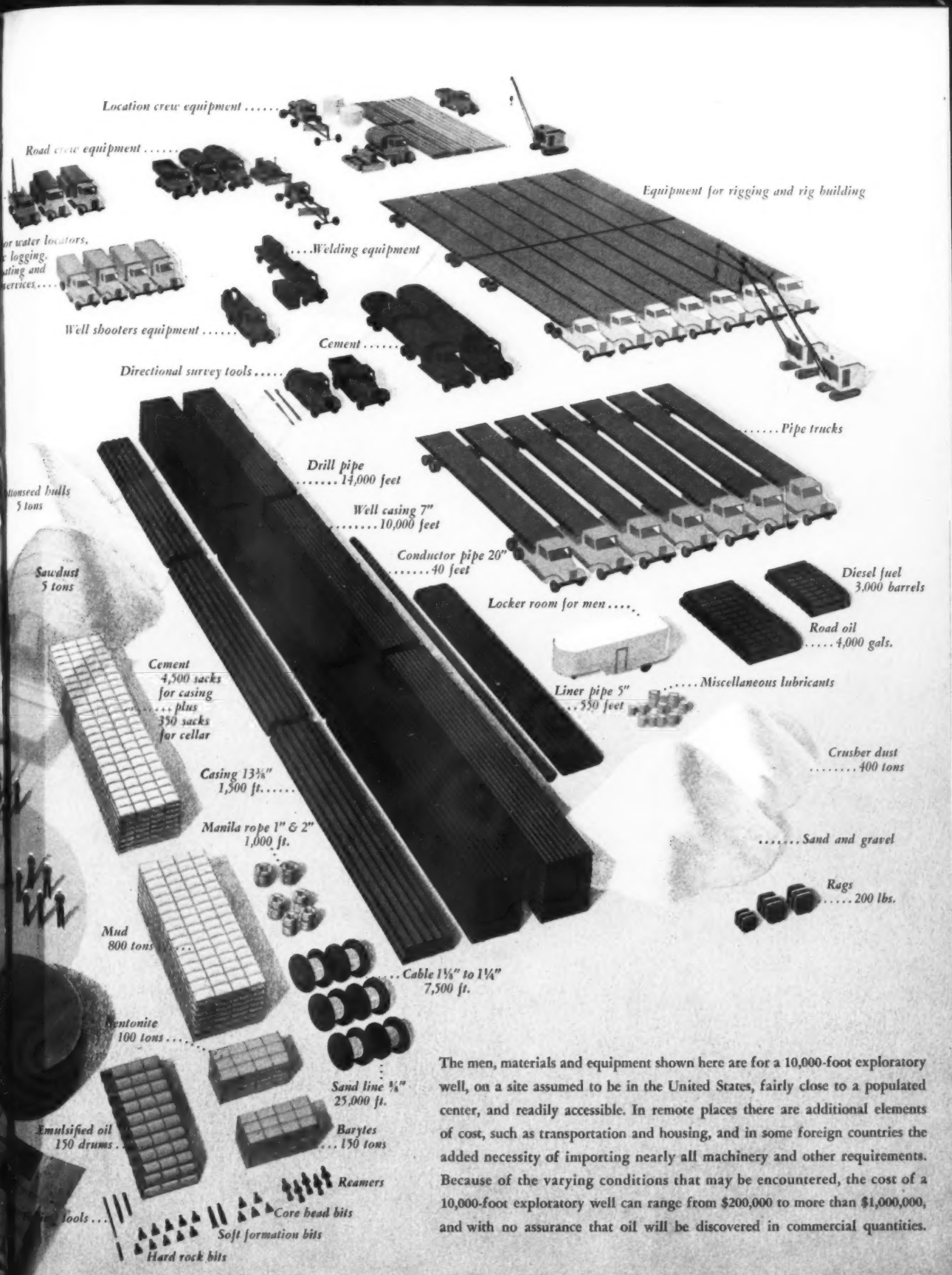
The Journal also has examined comprehensively the makeup of mechanical equipment employed in contract drilling. For information on this phase refer to the previous Annual Drilling Issue, dated September 22, 1949.

*Note—During the time the individual drilling contractors were interviewed for census purposes, rigs were going into service and others were being stacked. For final compilation purposes, therefore, the figures have been adjusted to an activity level when 1,977 rigs were being operated by 765 rotary-drilling contractors. Idle rigs at that time were, of course, not included.

***ROTARY CONTRACTORS CENSUS.**—Examining the completed work are the Journal men who did the job: Neil Williams, associate editor; K. B. Barnes, engineering editor; D. W. Wilson, J. W. Brownlee, and D. B. Miller.*

XUM


Recording helpers
Assistant observer
Observer
Party chief
Computers
Helpers
Permit man
Geologist observers
Drillers
Seismographic crew
Shooter
Helper
Company geologists used for decision
Field personnel
Surveyor
Helpers
Surveying gang attached to seismic crew
Geologists (reconnaissance)
Legal talent
Leaser
Transit man
Helper
Surveyor
Surveyor
Operators
Engineer
Equipment operators
Road building
Gang pusher
Gang pusher
Engineer
Preparing location ("on well" men)
Riggers
Truck drivers
Assistant foreman
Rig up foreman
Riggers (derrick builders)
Shooter
Helper
Well shooting crew
Operator
Helper
Deviation & directional Survey crew
Operator
Helpers
Operator
Helper
Water locating crew
Service man
Fishing crew
Foreman
Helpers
Well logging crew
Core analysts
Geologist
Coring analysis crew
Inspector
Inspector
Petroleum engineer
Test operator
Geologist
Cementers
Gas man
Bulk truck operators
Foreman
Petroleum engineers
Cementing crew
Formation tests crew
Miscellaneous electricians carpenters mechanics
Rotary helpers
Drillers
Drilling foreman
What It Takes to Drill a
$750,000
Wildcat

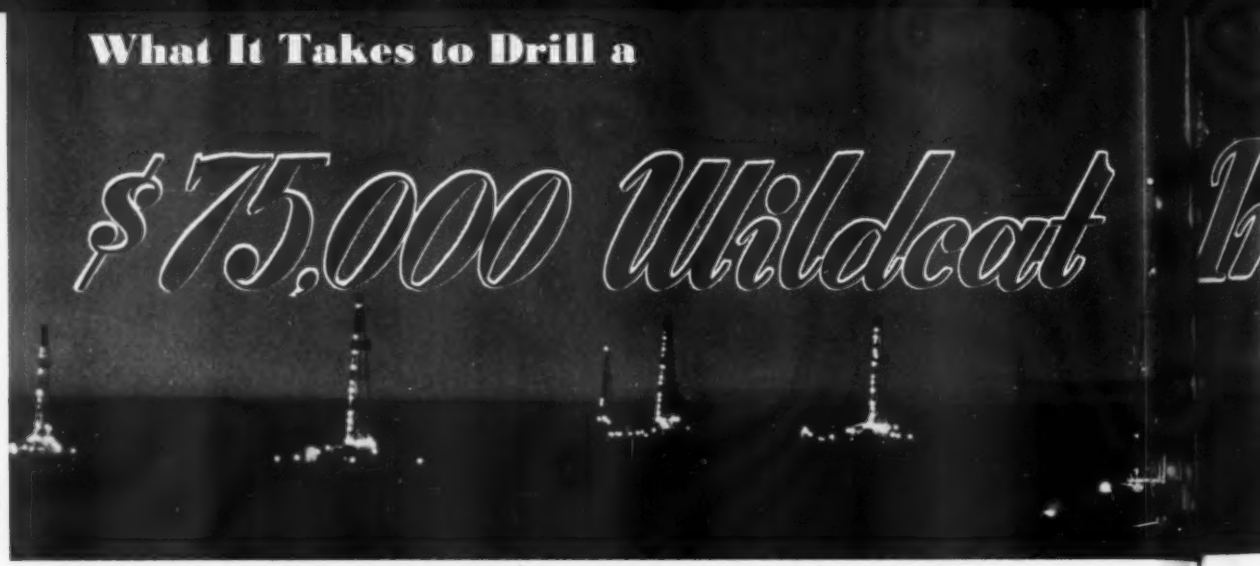


The men, materials and equipment shown here are for a 10,000-foot exploratory well, on a site assumed to be in the United States, fairly close to a populated center, and readily accessible. In remote places there are additional elements of cost, such as transportation and housing, and in some foreign countries the added necessity of importing nearly all machinery and other requirements. Because of the varying conditions that may be encountered, the cost of a 10,000-foot exploratory well can range from $200,000 to more than $1,000,000, and with no assurance that oil will be discovered in commercial quantities.

XUM

What It Takes to Drill a

$75,000 Wildcat



West Texas' Scurry reef areas are the scene of some of the busiest drilling activity in the world. In a relatively short time, this medium-depth area (6,000-7,000 ft.) alone has accounted for over 1,500 miles of hole making. These pages show what it takes in the way of (1) manpower, (2) equipment and supplies, and (3) services, to drill a well in this territory. The average cost is about $75,000 per well.

WEST Texas' new reef fields have set off a drilling campaign (and the establishment of more new oil reserves) that probably has not been exceeded since the discovery and drilling development of the great East Texas field 20 years ago. The leasing and drilling activity includes Kent, Borden, Howard, Mitchell, Nolan, Fisher, Stonewall, Garza, and other neighboring counties—but Scurry County has been and is predominantly important. Here are some high spots of drilling activity in Scurry:

Since the initial Scurry County reef discovery, rotary contractors have drilled 1,264 wells (through third quarter 1950), and drilling is continuing at a rate to bring in about 115 new producers per month. Current drilling activity for Snyder-Kelly field is running at a rate to average 60 new completions per month, 20 for Diamond M, and 20 for Cogdell fields, and about 15 for the Sharon Ridge Canyon reef area.

MEN:

Tool Pusher	1
Drillers	4
Roughnecks	16
Production Supervisors	2
Petroleum Engineers	2
Geologist	1
Casing-cementing Crew	9
Well Servicing Crew	5
Rig Building Crew	5
Electric Logging Crew	3
Acidizing Engineers	2
Drill Stem Tester	1
Surveyors	3
Truck Drivers And Helpers	18
Equipment Operators	3
TOTAL	75

Days required to drill	40
Days required for completion	10
TOTAL	50

AVERAGE COST
$75,000

For the drilling done this year, completion data are: North Snyder had 165 finished oil wells at the time it was officially joined with Kelly field and was averaging about 10 new wells per week. In Kelly, 139 wells had been completed during the same period, and total oil wells finished during the first 9 months of this year was 332.

In Diamond M field, oil completions to October 1950 are 142. Completion reports reached 20 per month by May of this year and have held fairly steady.

***MANPOWER?** Multiply this busy scene by three crew tours per day, and by over 200 similar operations. That represents drilling activity in West Texas' reef areas!*

EQUIPMENT AND SUPPLIES:

Rotary Rig	1
Drill Pipe	7,000 feet
Drilling Bits	60
Butane	32,000 gals.
Water	15,000 bbls.
Mud	1,500 sacks
Casing 5 ½" 50 tons	6,800 feet
Casing 7 5/8" 25 tons	1,800 feet
Cement	1,250 sacks
Special Service Trucks	5
Well Servicing Truck	1
Tubing 2" 15 tons	7,000 feet
Bulldozer	1
Hauling Trucks	9

SERVICES:

	% of Total Cost
Preparing well site (surveying, road building, grading, excavating.)	2
Drilling (installing equipment, rigging up, drilling.)	63
Special services (running and cementing casing, taking drill stem tests, coring, running electric log, acidizing.)	25
Well completion (installing tubing and surface equipment, swabbing and testing, cleaning up around well.)	10
TOTAL	100%

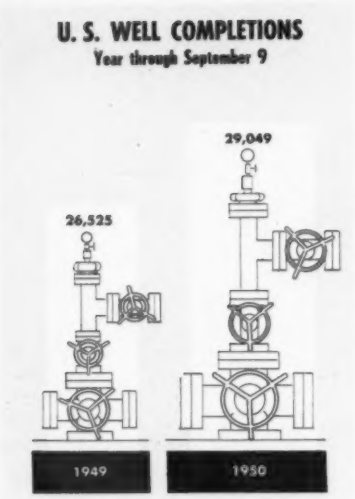
Cogdell has had 130 completions to October 1. This was a 1950 discovery and by midyear, completion reports were being filed at an average of 20 per month. Further development will exceed that pace.

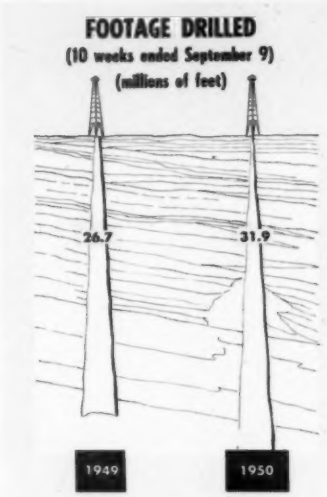
Sharon Ridge Canyon field, which geologists hold is not yet defined, has had 79 reef producers to October 1 and new wells are being added at the rate of 15 per month under steady development programs.

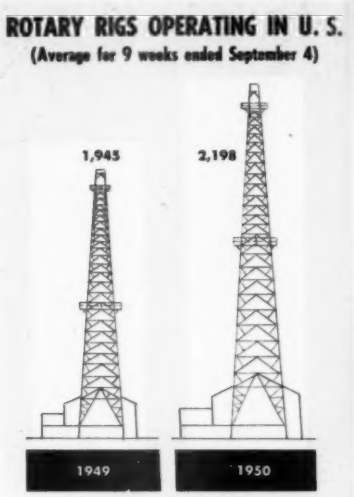
Footage data on the reef fields, on wells drilled this year, are: In the Kelly-Snyder area, development drilling is adding some 410,000 ft. per month to the year's total of over 4,420,000 ft. This figure also includes 11 dry holes in the area. Drilling at Diamond M accounts for over 1,035,000 ft. and includes six dry holes. In the Cogdell field of both counties, completion footage is over 873,000 ft., which includes three dry holes. Sharon Ridge has added some 542,000 ft. for wells drilled during the same period.

EQUIPMENT? Add to this complete modern rig and all its auxiliaries, over 200 more of the same. Result equals the Pennsylvanian Canyon reef oil pay!

***SCENE ABOVE** is portion of the great Snyder-Kelly field, as the sun fades and rig lights go on.*







DRILLING TRENDS

TOTAL footage drilled in the 10-week period ended September 9 was 19.7 per cent greater than in the same weeks of 1949.

Through the first full week in September, operators had completed 2,524 more wells in 1950 than in the same period last year. This represents an increase of 9.5 per cent.

West Texas accounted for 1,142 of the additional wells or 45.2 per cent of the total gain in completions.

Completions in Oklahoma for the same period were up 24.5 per cent from last year.

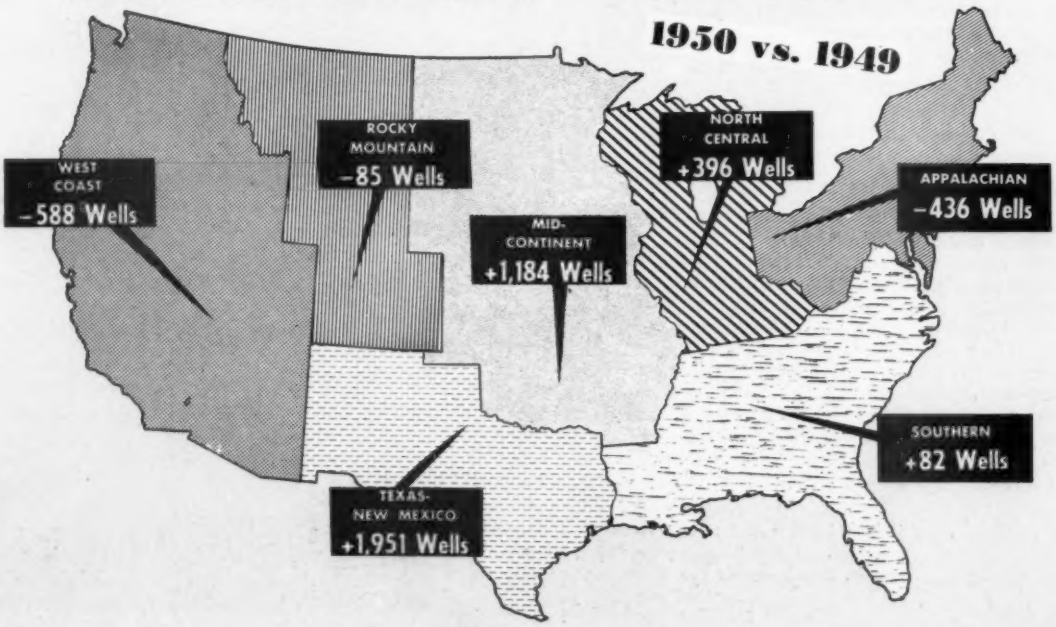
Rotary rigs operating in United States in the 11-week period ended September 11 averaged 2,204, a gain of 255 rigs or 13.1 per cent over the same weeks in 1949.

For the same period, completion footage in principal rotary-drilling areas was up about 21 per cent from last year.

Comparison of the 21 per cent increase in footage with the 13 per cent gain in number of rigs indicates additional improvement in drilling efficiency.

Completions in the last half have been running on schedule. Total completions through the first week of September represented 38.5 per cent of wells programed for the last half as reported at midyear in The Oil and Gas Journal forecast. Actual completions in the same period last year amounted to 38.6 per cent of total completions for the last half of 1949.

WELL COMPLETIONS TO SEPTEMBER 9



DEEP ROTARY DRILLING

THIS is the story of present-day deep rotary drilling. It concerns a well drilled by Ohio Oil Co. with the latest modern rotary rig and with veteran drilling personnel who have the know-how to make deep hole. The material which follows is an unusually detailed, informative, and interesting presentation of the various stages of today's rotary-drilling operations, from building derrick to cementing casing.

In late fall (November) location for the well (West Branch field, Ogemaw County, Michigan) was surveyed and road built for moving in the heavy derrick parts and rotary equipment. On December 22, members of the rig contractor's crew started excavating cellar and derrick foundations. In the subzero weather it was necessary to lay more than a mile of steam coils and cover them with sheet iron to thaw out the ground for excavation.

In 10 days' time the crew had not only completed excavations but had poured concrete for cellar and derrick foundations.

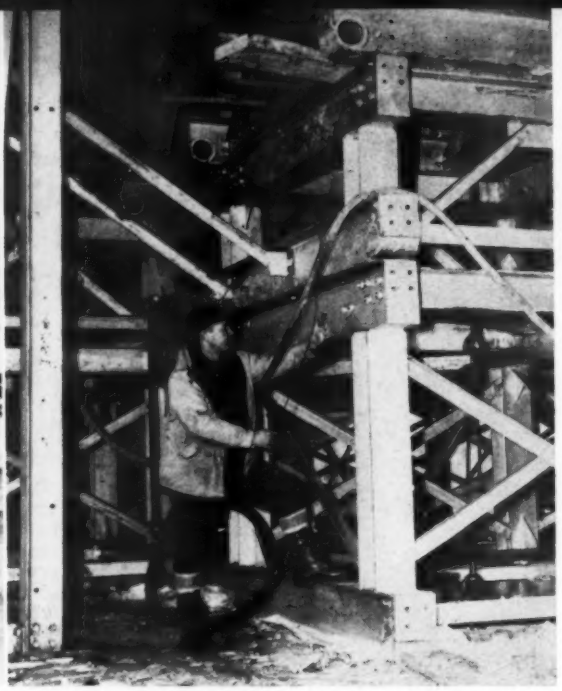
On January 2 with the temperature 33° below zero, rig builders started building derrick and had it and substructures completed by January 13.

Numbers on the derrick photo refer to the following:

1. **Portion of the substructure,** 9 ft. 3 in. high, supports the 21-ton load of four 340-hp. gas engines which power the rotary.

2. **Portion of the substructure,** 13 ft. 3 in. high, supports the draw works weighing more than 38 tons. The engine and draw-

Photo of 192-ft. derrick taken before rigging up. One corner of Ohio Oil Co.'s 10-story general office building is shown beside the derrick for comparison.



Extreme left: In Michigan's sub-zero weather the ground was overlaid with steam coils in turn covered with sheet iron to thaw the earth for excavation.

Left: Petroleum engineer measures engine and derrick substructures.

works substructure is separate from the derrick-floor substructure, so that vibrations from the heavy machinery will not be transmitted to the derrick and derrick floor.

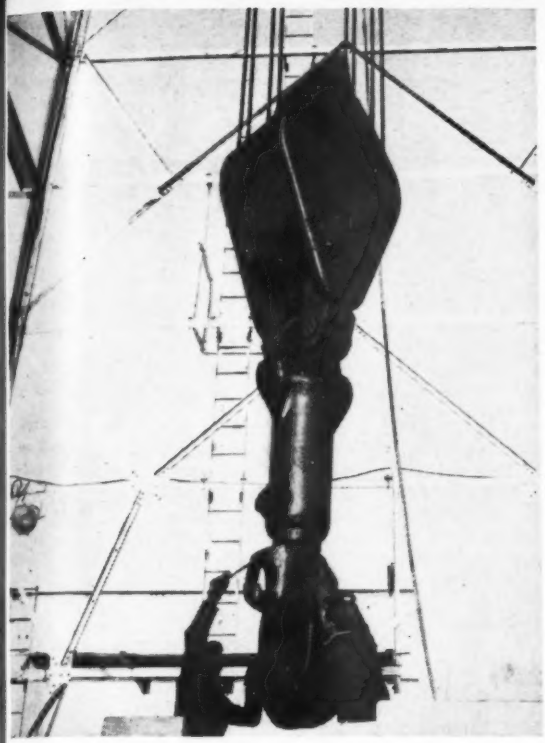
3. **Derrick-floor substructure,** 13 ft. 3 in. high, supports the tremendous weights of drill pipe and casing on the derrick floor. The legs of the derrick are extended, so that the substructure independent of the derrick can be moved in or out. A special safety feature of the substructure is the ease of access to the cellar, blowout preventer, and master gate controls. Cantilever-type supports eliminate the hazardous crossbracing of the usual type substructure. There is enough clearance to drive a 2-ton truck under the supporting beams. The substructure has casing or drill-pipe-support capacity of 450,000 lb. and a rotary-table support of 300,000 lb. Derrick floor space is 30 by 30 ft.

4. **The pipe rack,** on which is stacked lengthwise the casing and drill pipe as needed, has an over-all length of 40 ft. and width of 16 ft. It is made up of four prefabricated steel units, 3 ft. 9 in. high, 8 ft. wide, and 20 ft. long. The rack will support a casing load of 400,000 lb.

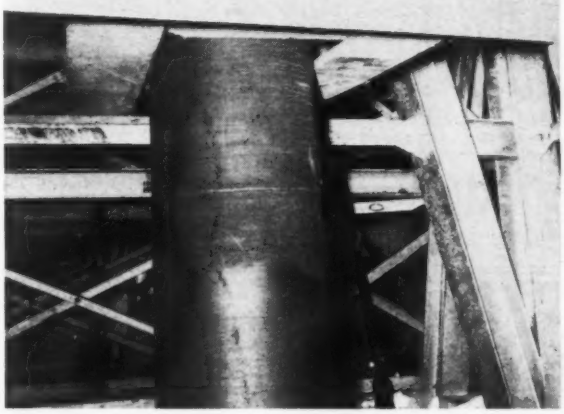
5. **The offset safety ladder** continues up the derrick to the crown block. Note the five safety platforms with the sections of ladder offsetting from each like a fire escape. This arrangement provides resting places and eliminates the danger of falls from fatigue or sickness.

6. **The runaround** provides a safety platform on the outside of the derrick at the level of the "fourble" board, which is placed inside the derrick. The fourble board derives

Concrete is poured for rig foundation.



Above: Weighing more than 5 tons, the traveling block has a capacity of 360 tons. The block has five 88-in. manganese-steel sheaves.



Upper right: Motorman and derrick man inspect safety latches on the hook to see that they are in proper working order. The latches prevent the elevator or other suspended loads from jumping the hook. Weighing nearly a ton, the hook has a carrying capacity of 300 tons. During the actual drilling, the swivel will be hung on the hook. However, in hoisting the drill pipe or casing, the elevator bails will be on the hook.

Right: Driller lines up a joint of 26-in. conductor pipe. At this spot hole was started and drilled with a 30-in. bit to a depth of 40 ft. Conductor pipe, welded at the joint, was then run into the hole and cemented up to the cellar floor. A flow nipple to vent return mud to the mud flume was cut into and welded on the portion of the conductor pipe extending above cellar floor.

its name from the four joints of drill pipe which make up a stand.

The principle of rotary drilling is simply a giant hollow drilling string of steel pipe with a bit on its business end. The drilling string, consisting mainly of 30-ft. sections of drill pipe, drill collars, and bit, is spun by the rotary table and thus bores into the earth. At approximately each 30 ft. of new hole, another section of drill pipe must be added to the string. However, when the bit becomes dull and it is necessary to pull the entire drilling string to change bits, the string is broken apart every four joints: hence the name "fourble." On smaller rotaries the drill pipe is usually broken apart (unscrewed) either in thribles, doubles, or singles.

On the fourble board will be stationed the derrick man whose job is to latch on the elevators or unlatch the elevators from the fourbles and guide the upper ends of the fourbles into or out of the pipe rack at side of derrick as the drill string is being broken apart and racked or made up to go back in the hole.

7. **From the crown-block safety platform** riggers and derrick men have easy and safe access to the crown block. A steel cable is strung through the sheaves of the crown block and the traveling block. The cable is spooled on the drum of the draw works powered by the gas engines. Attached to the traveling block is the hook. This makes up a gigantic block and tackle to lower and raise the tremendous loads of drill pipe and casing.

8. **Atop the derrick** is the gin pole used principally for placing the 8,560-lb. crown block during rigging up.

The derrick assembled from prefabricated angle steel weighs 67,037 lb. Fully rigged, the derrick, engines, draw works, crown block, traveling block, and hook can readily hoist and control 300 tons, the weight of a modern steam locomotive and tender.

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Rotary Equipment

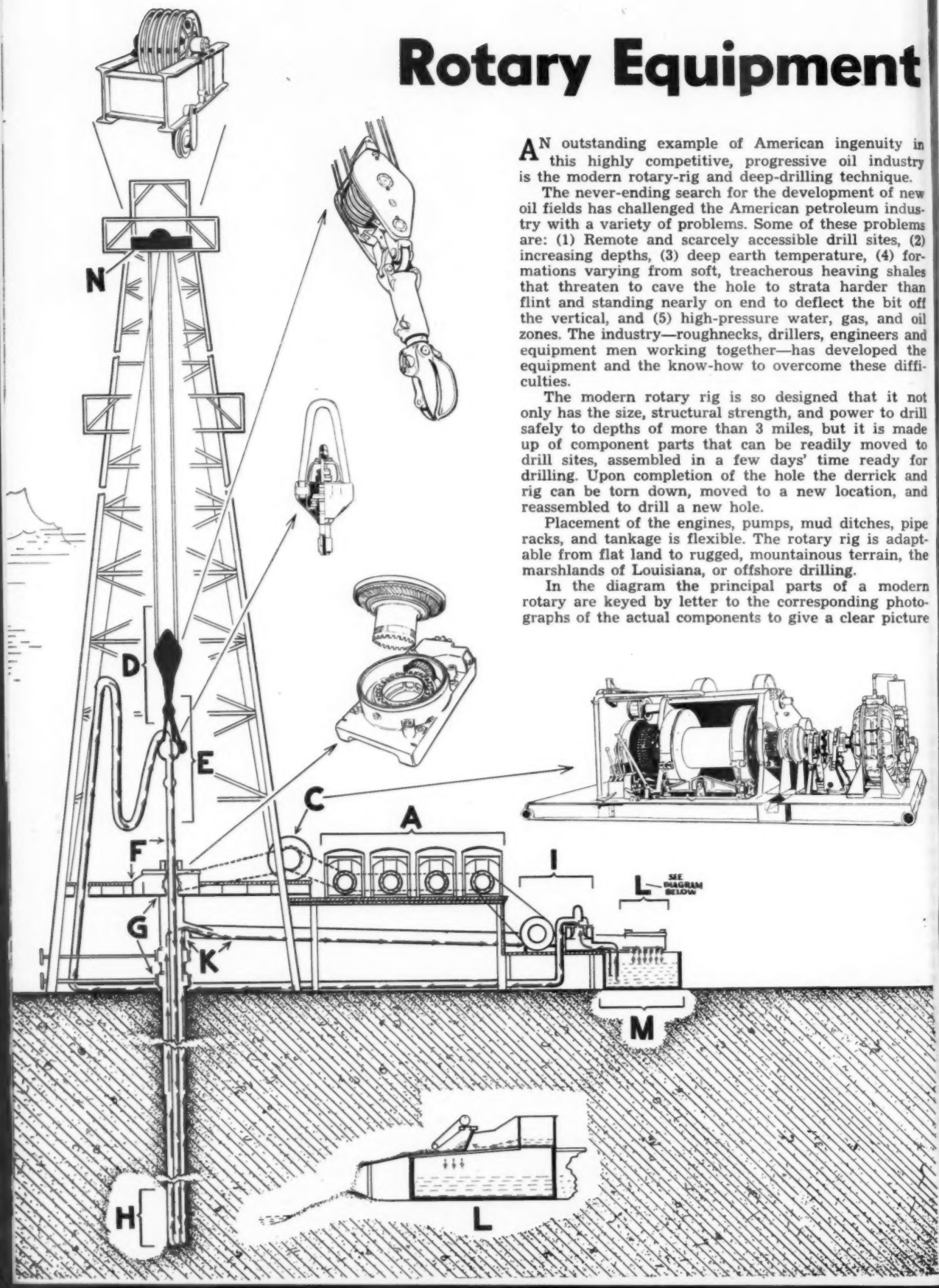
AN outstanding example of American ingenuity in this highly competitive, progressive oil industry is the modern rotary-rig and deep-drilling technique.

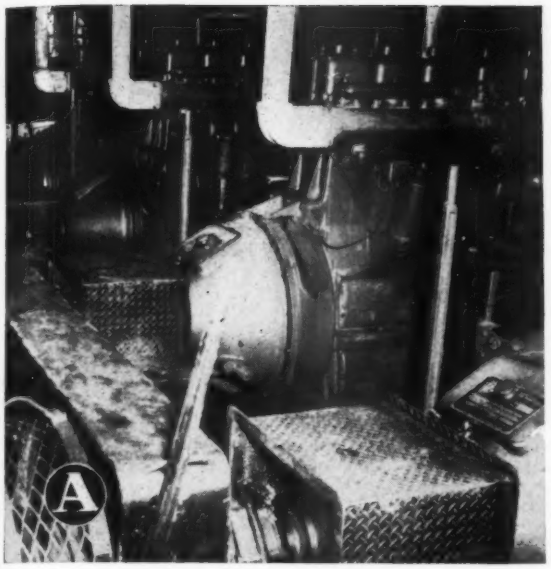
The never-ending search for the development of new oil fields has challenged the American petroleum industry with a variety of problems. Some of these problems are: (1) Remote and scarcely accessible drill sites, (2) increasing depths, (3) deep earth temperature, (4) formations varying from soft, treacherous heaving shales that threaten to cave the hole to strata harder than flint and standing nearly on end to deflect the bit off the vertical, and (5) high-pressure water, gas, and oil zones. The industry—roughnecks, drillers, engineers and equipment men working together—has developed the equipment and the know-how to overcome these difficulties.

The modern rotary rig is so designed that it not only has the size, structural strength, and power to drill safely to depths of more than 3 miles, but it is made up of component parts that can be readily moved to drill sites, assembled in a few days' time ready for drilling. Upon completion of the hole the derrick and rig can be torn down, moved to a new location, and reassembled to drill a new hole.

Placement of the engines, pumps, mud ditches, pipe racks, and tankage is flexible. The rotary rig is adaptable from flat land to rugged, mountainous terrain, the marshlands of Louisiana, or offshore drilling.

In the diagram the principal parts of a modern rotary are keyed by letter to the corresponding photographs of the actual components to give a clear picture





A. FOUR 350-HP. ENGINES, seen from back of the engine compound drive toward the draw works. The engine group and draw works are set on a separate steel substructure 4 ft. below derrick-floor level. The engines are compounded (connected) by roller chains and sprockets, so arranged that any one or combination of engines can be used to meet varying power requirements. All chains, enclosed in oil-tight guards, are lubricated. The guard (lower right), covering the coupling between Engine No. 4 and the compound, forms a nonskid step as do the guards over each coupling. Ample space is provided between engines for easy access and safe working conditions. B. THIS 350-HP. ENGINE is identical to those in four-engine group which power the draw works. It is one of two which drive the 500-hp. and 300-hp. independent slush pumps. These pumps, located back of the rig, are used to maintain circulation of the mud whenever it is necessary to shut down the draw-works engines. Engineman is checking the oil level in the 23-hp. motor used to start the big engine. The engineman, 6 ft. tall, gives graphically the size of one of the six engines that power the big rotary. The radiators are 7 ft., 7 in. high; in each engine the cooling system holds 70 gal., 35 of which are antifreeze; the lubricating system holds 30 gal. of lube oil.

of the over-all working of the rotary rig.

The group of four 340-hp. engines (A) drives the draw works (C). The draw works is the work horse of the rotary. It consists essentially of a large hoisting drum around which is spooled a steel cable. This cable is strung around the sheaves of the crown block (N) and of the traveling block (D). This makes up a huge block-and-tackle assembly to support, raise, and lower the drilling string.

(In addition, the draw works, traveling block, hook, and elevators are used to lower casing into the hole, to pick up and move heavy pieces of rotary equipment. By use of the catheads of the draw works power is transmitted to make up or break strings of drill pipe or casing. These operations will be explained later in detail.)

Weighing nearly a ton and carrying capacity of 300 tons, a steel hook is attached to the lower end of the block. On this hook is hung the entire drilling string. The drilling string, hollow throughout its entire length, is made up of a swivel and kelly (E), then sections of drill pipe (according to the depth and size of the hole, the drill pipe varies in size such as 3½, 4½, 5⅞-in., or other diameters) followed by several sections of drill collars, and the bit (H).

The drill collars have thicker walls than the drill pipe to place added weight at the bottom of the drilling string on top of the bit. This makes for smoother, faster drilling and straighter hole. In this particular test eight 8-in. drill collars, 40 ft. in length and weighing 128 lb. to the foot, were used. This compares with the 21-lb. per foot weight of the drill pipe. Thus 40 tons of weight were concentrated in the last 320 ft. immediately on top of the bit.

The kelly is square shaped (see No. 11, Photo E and No. 1, Photo F), so that as it is fed through the revolving rotary table (F) the entire drilling string with the bit on the business end is rotated, boring into the earth to make hole. The rotary table in this particular rig is chain driven by the draw works.

The engine group also powers, through a belt connection, the slush pump (I). The pump sucks mud out of the mud tank (M). The course of the mud is indicated by the red arrows and can be easily traced through the pump out the pump discharge line, under the derrick, up the standpipe, through the flexible rotary hose, and into the swivel connection. From here it flows down through the hollow kelly, drill pipe, drill collars, and out the channels of the bit. It then circulates up the hole in the annular space between the outside of the drill pipe and the wall of the hole and the inside wall of the casing. The mud is vented out the casing (G) into the steel ditch (K) which carries it to the shale shaker (L). The mud flows through the screens in the shale shaker back into the mud tank (M) to be sucked up by the slush pump (I) and recirculated through the mud system.

The shale shaker (L) of which a detailed diagram appears at the bottom of the large diagram, screens out the coarse cuttings brought up by the mud and the vibrating screens shake these cuttings onto the apron of the shaker where they drop into the shale pit. Thus as the mud flows back into the mud tank it is kept fluid and of an even consistency.

The drilling mud serves five important purposes:

1. It brings the cuttings out of the hole.

2. It cleans, cools, and lubricates the bit.

3. Pumped in under heavy pressure, it plasters the wall with a stiff cake of mud, lessening the danger of the hole caving.

4. The pressure and the weight of the mud in most instances holds down any inflow from water-bearing sands while drilling. This eliminates running strings of casing between the surface casing and the production string. In the older cable-tool method of drilling it was usually necessary to run several strings of casing in order to shut off water sands. This was not only expensive and time con-

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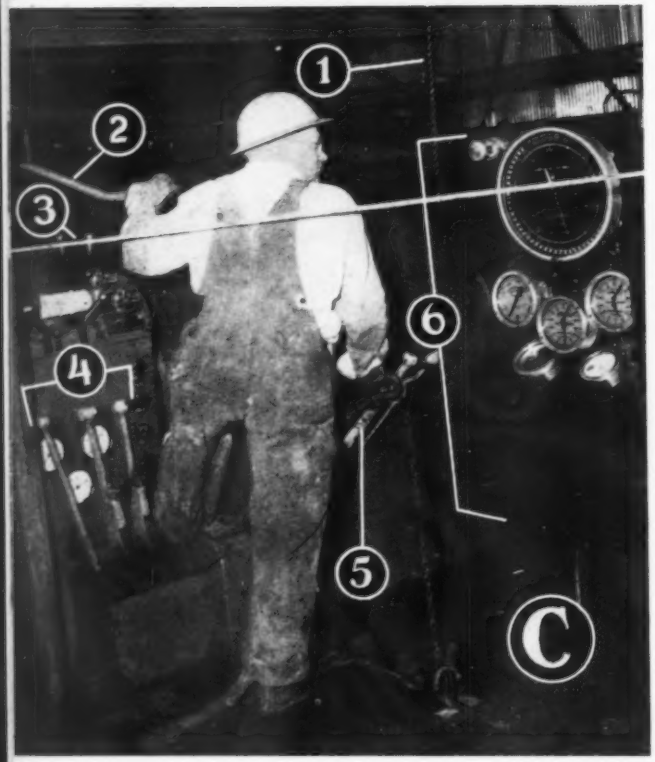
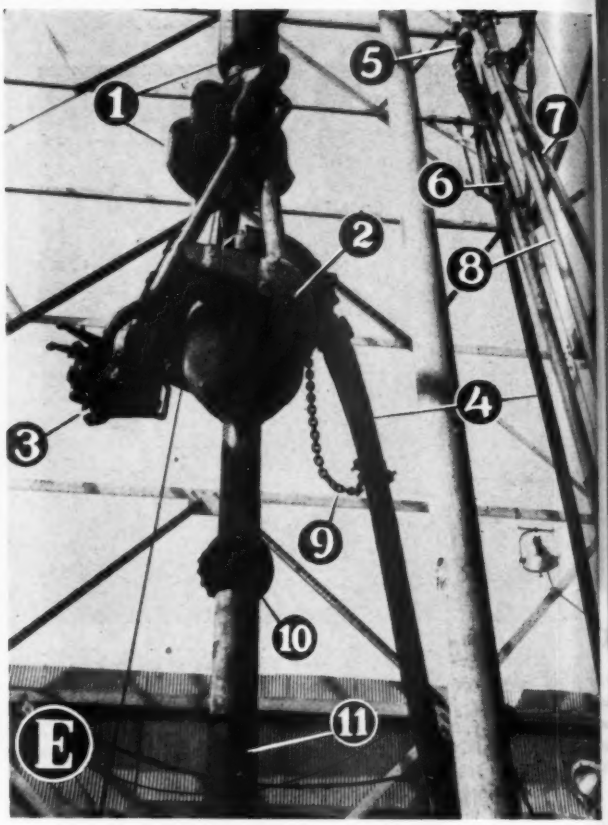
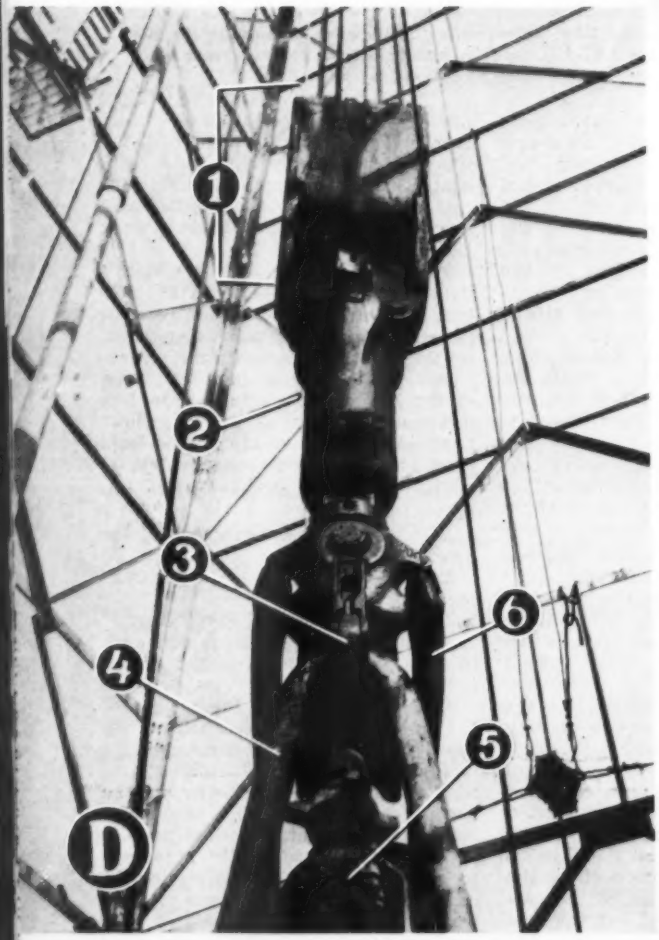






ROTARY EQUIPMENT (Continued)

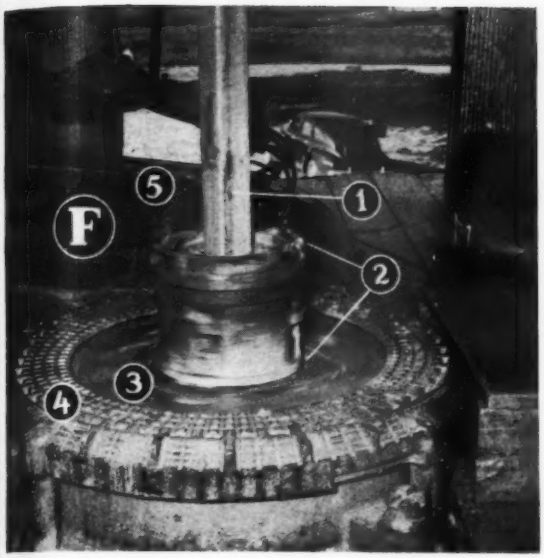
suming, but progressively reduced the size of the hole, thus considerably limiting the depth of drilling.

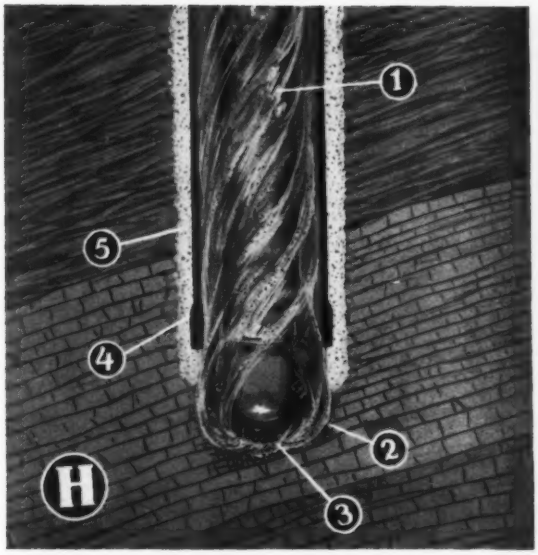
5. The weight and pressure of the mud controls high-pressure oil and gas zones. This makes for safe working conditions and conserves valuable oil and gas. Gone are the gushers of 20 years ago, colorful as they may have been, blowing oil and gas over the crown block. Completion of a well by modern rotary practice with proper mud control saves thousands of barrels of oil and millions of cubic feet of gas, reduces to a minimum the hazards of fire, and the possible loss of the well and equipment.

C. VIEW OF THE DRAW WORKS. *The steel cable (1) runs from the hoisting drum up the derrick and is strung through the sheaves of the crown block and traveling block. In this particular operation the crew is going back into the hole with the drilling string after changing bits. The equalizing brake on the drum is set, so that a fourble (four sections of drill pipe) is supported hanging in the elevator on the hook attached to the traveling block. Thus supported the fourble can be spun into and tonged up for tight connection in making up the drilling string. Driller stands at his post, operating the spinning cathead clutch lever (2). The spinning line (3) runs from the cathead to the drill pipe extending above the rotary table not shown in this picture. The group of levers (4) operates various clutches actuating the drum shaft, rotary-table shaft, and the high and low-speed groups in the transmission. Driller is holding down the drum brake lever (5) in his right hand. The various dials on the instrument panel (6) show weight of the drilling string, and pressure, engine speeds, rotary-table speed, and other pertinent information.*

D. THE 360-TON TRAVELING BLOCK *(1); the shank of the hook (2); the lower locking arm (3) which secures the swivel bail (4) hanging on the hook; the mud-hose flange connection (5); and the drill-pipe elevator links (6).*

E. A SIDE VIEW OF THE HOOK *(1), and the swivel (2) which allows the kelly to rotate freely yet forms a tight seal against the escape of mud, oil or gas. The drill-pipe elevator (3) hangs out*





ROTARY EQUIPMENT (Continued)

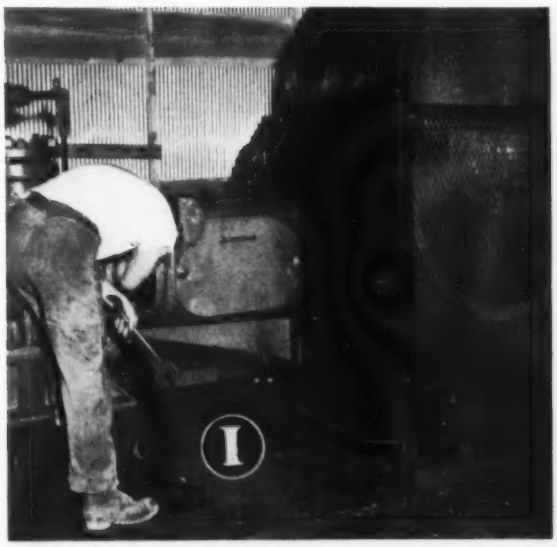
...t the way when the well is drilling. The mud hose (4) connects ...rom the swivel to the gooseneck (5) on the standpipe (6). The ...umbers (7) and (8) point to the auxiliary mud hose and stand-...ipe. Other parts are the mud-hose safety chain (9); the kelly ...topcock (10) and the top portion of the square shank of the kelly (11).

F. SQUARE SHANK OF THE KELLY (1) extends down through the ...elly bushing (2) which rotates with the table (3) revolving the ...elly and the entire drilling string. Number (4) indicates the ro-...ary table guard, and (5) is the rotary drive-chain guard encasing ...he chain drive from draw works to the rotary-table sprocket.

G. GROUND-LEVEL VIEW under the derrick floor shows the con-...uctor pipe (1). The pipe (2) is the flow line which vents return-ing mud to the steel mud ditch. Numbers (3) and (4) are blow-out preventers, special high-pressure valves to shut in the well if a high-pressure gas or oil zone is encountered which the mud will not hold down.

H. BUSINESS END OF DRILLING STRING, the heavy drill collar (1) and the rock bit (3). The mud (2) which has been pumped down the drilling string, starting at the swivel, courses out the channels of the bit and circulates up the hole in the space between the drilling string and the casing (4). Number (5) indicates the cement around the casing.

I. FLUID PISTON-ROD STUFFING BOX is adjusted by derrick man on the 500-hp. pump, the heart of the mud-circulating system. Note the safety guard enclosing the V-belt drive from the engine compound to the pump. All exposed moving parts have been enclosed in guards to provide safe working conditions. When the pump is running at 60 s.p.m., the pump drive sheave (large wheel) makes 370 r.p.m.



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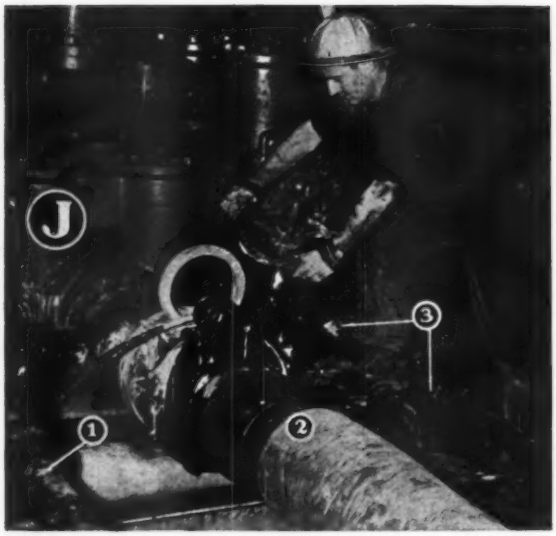
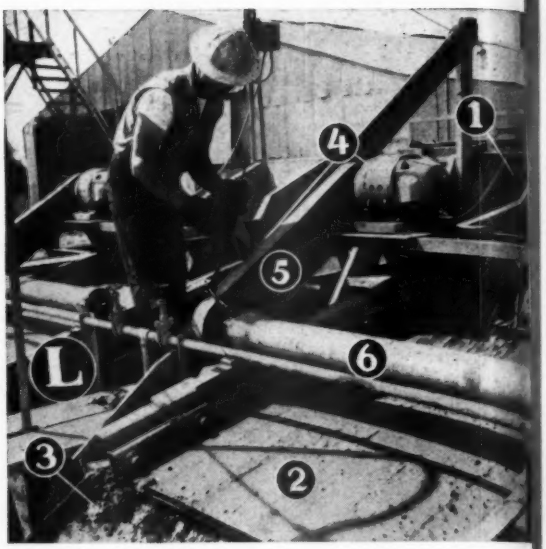


ROTARY EQUIPMENT (Continued)

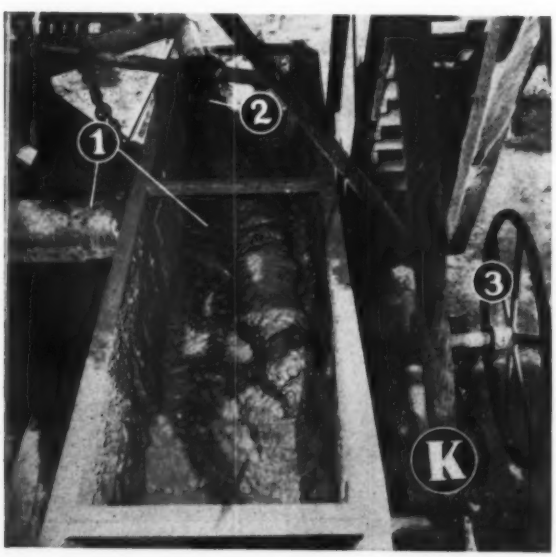
J. ONE OF THE 500-HP. PUMPS. A suction-line valve is being opened. One of the 500-hp. pumps is always in use circulating mud. The other is a standby powered by engines independent of the draw-works engine-drive group, so that when the draw works is shut down the standby can be used to maintain circulation. These pumps weigh 18 tons each, will pump 840 g.p.m. Maximum pressure is 2,000 psi. at rated horsepower. Number (1) is the suction line to mud storage tanks, (2) is suction from mud tanks to pump and (3) is water line to pump suction.

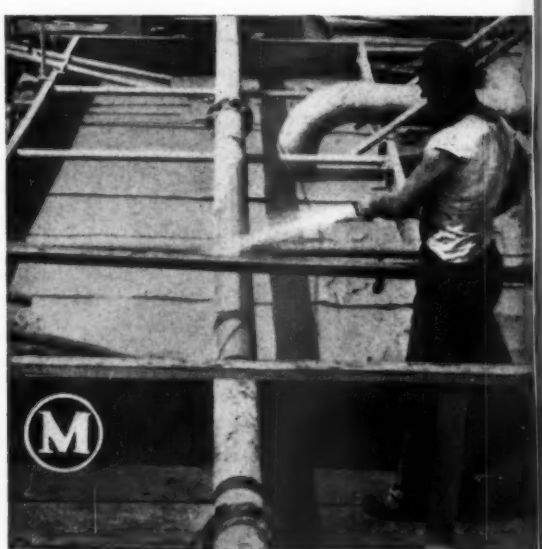


L. THE SHALE SHAKER into which the steel ditch empties the returned mud. Mud from the ditch is released by the gate (1) and flows on to the screen (2) which vibrates at the rate of 1,800 times per minute. The fluid portion of the mud passes through the screen into the mud tank below while the coarse bit cuttings are jiggled on to the apron (3) and fall into the shale pit at the edge of the apron. The electric motor (4) through the guarded belt connection (5) drives the vibrating mechanism (6). Rotary helper is lubricating one of the bearings on the shale shaker.

K. THE MUD DITCH. The return flow pipe (1) empties the mud into the steel ditch from the well. This pipe is an extension of the pipe indicated by number (2) in G. The pipe (2) in K is the jet line to pick up surplus mud from the cellar. The handwheel extension (3) manually operates the blowout preventer.

M. THE MUD TANKS. Water is being added to reduce the viscosity of the fluid. The large pipe making a bend down into the mud is the suction line of the 500-hp. pump driven by the compound of the four-engine group. This line shown connecting to the pump at (2) in J, sucks the mud into the big slush pump which discharges the mud back into the circulating system.





Drilling Operations

SOME of the description given in preceding sections is reviewed in order to summarize the procedure followed in making hole. In the rotary-drilling method hole is made by rotating a string of drill pipe and drilling bit attached at the bottom of the string. Power for rotation is supplied by the draw-works engines operating through the rotary table on the derrick floor. At the top of the drilling string is a square or hexagonal kelly which extends through the rotary-table drive bushing. The bushing rotates with the table and drives the kelly and the entire drill string and bit. The bushing also permits the kelly to move down while rotating. Additional lengths of drill pipe are screwed on to the string just below the kelly, as necessary, while making hole.

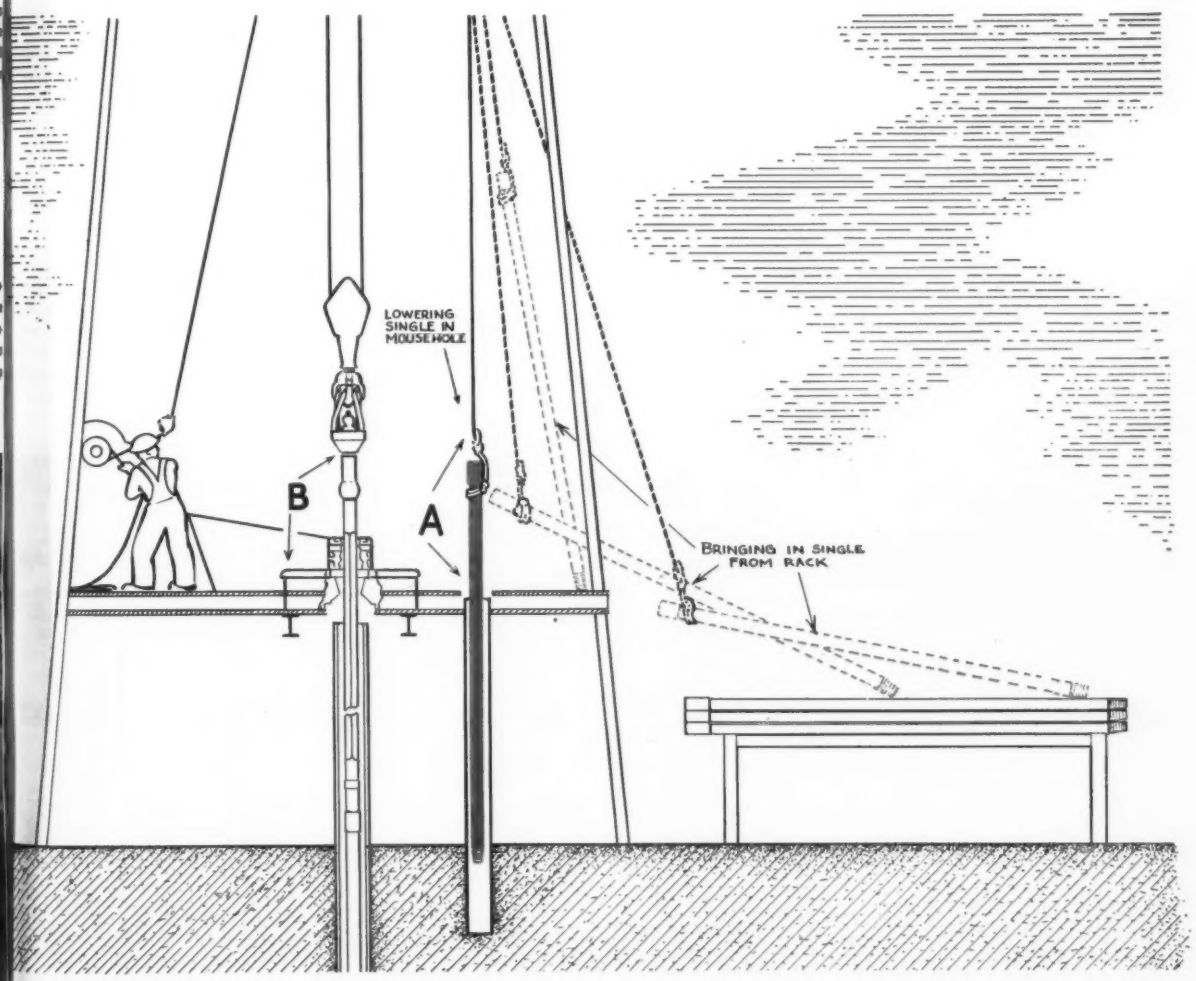
A mud or slush pump draws a large volume of drilling mud from the mud pit and pumps it at high pressure, down through the drill pipe. The mud comes out at high velocity through openings in the drilling bit, flushes out the drill cuttings, and seals the wall of the well as it returns to the surface through the annular space between the wall and the drill pipe.

Preceding photos have shown some of the features of the mud system, as well as the swivel and parts of the hoisting system. The swivel hangs on a forged-steel hook. The mud hose is attached to the upper stationary part of the swivel. The lower part of the swivel, holding the kelly, rotates with the drilling string. The hook is attached to a traveling block suspended by wire rope from the crown block at top of derrick. With the wire line running from the hoisting drum of the draw works and strung through the sheaves of crown block and traveling block, a hoisting system is created by which drill pipe can be raised or lowered when the line is reeled off or on the hoisting drum.

In making a round trip, as when the bit has become dull and must be replaced, steps are as follows: (1) the kelly and swivel are disconnected from the drill pipe and set to one side; (2) the draw works is used to pull the drill pipe which is supported by elevators suspended by the hook, and by slips in the rotary table; (3) pipe is broken out at every third (thrible) or fourth joint (fourble) and racked (stood up) in the derrick; (4) after replacing the bit, the thribles or fourbles go back into the hole, using the draw-works brake to control the speed at which the pipe is lowered.

Men in the oil business are continually introducing faster, more economical, and better methods of getting the job done. Men in the drilling end of the business are no exception. These innovations all add up to better products and better services at reasonable prices. They put the progress in petroleum. With the introduction of big rotaries for deep drilling in recent years, rotary men were quick to take advantage of the increased working space on the rigs by devising many time-saving practices.

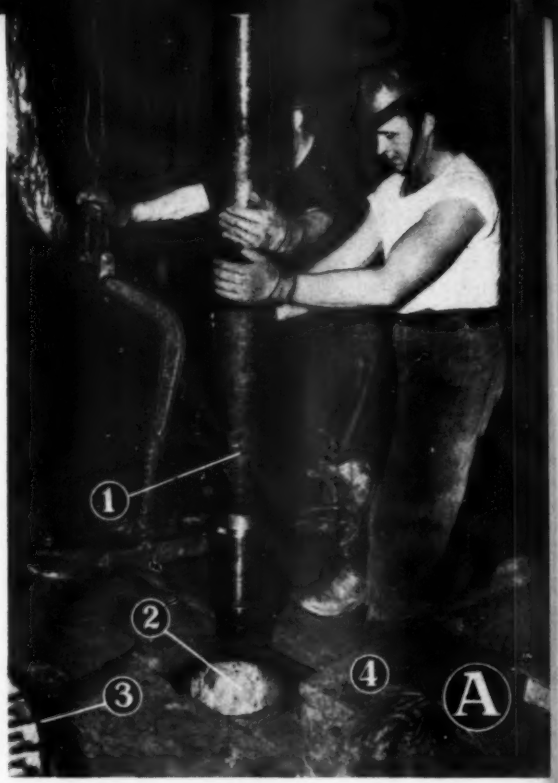
As a rotary drills approximately each 30 ft. of new hole, the drilling



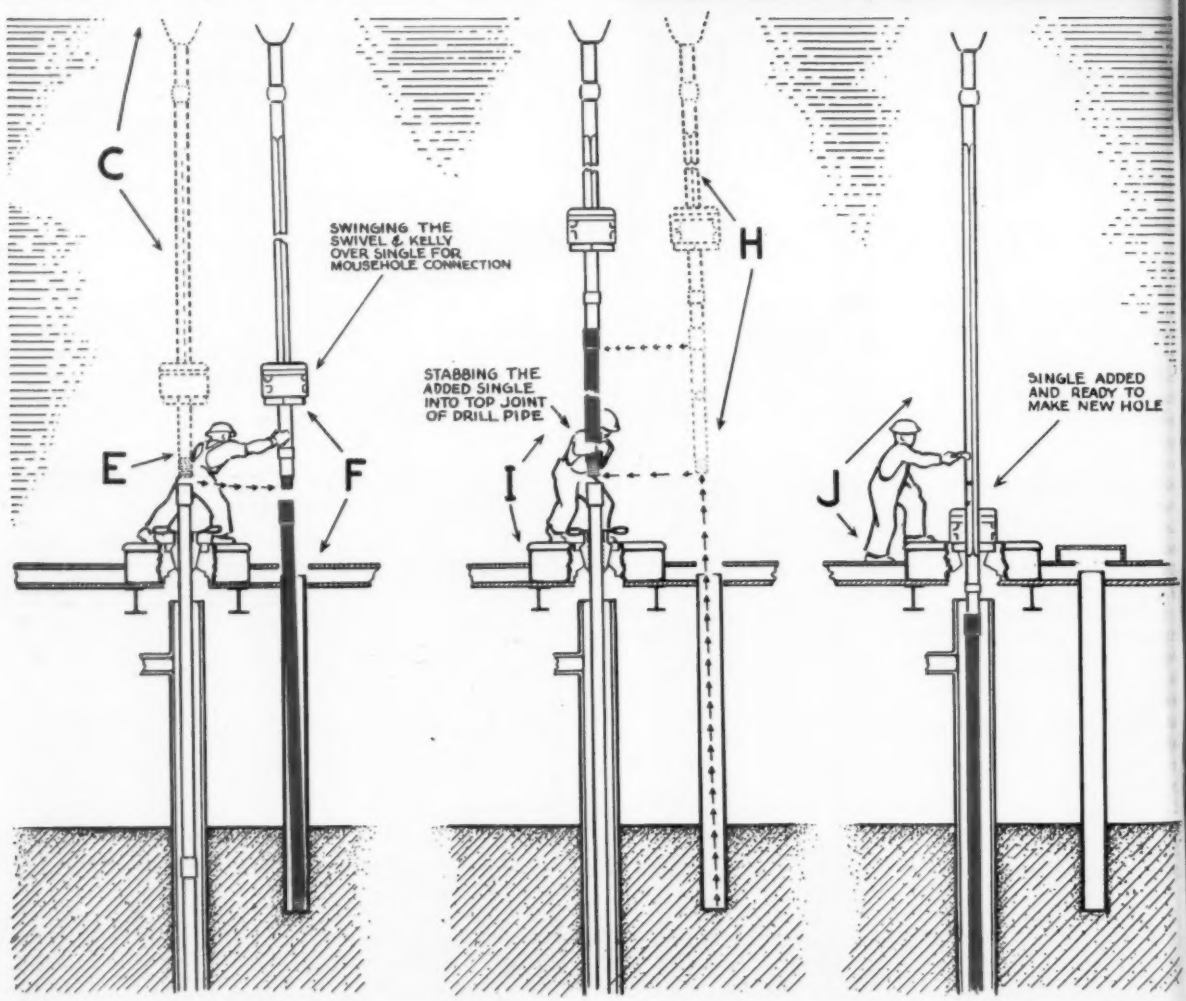
string must be lengthened in order to drill deeper. This is done by adding a single. On some rotaries the single is still added by breaking out (disconnecting) the kelly from the drilling string, swinging the swivel and kelly over, and lowering the kelly into the rathole (see photo J, No. 3). With the kelly out of the way in the rathole, the drill-pipe elevator is used to hoist the drill pipe into position to add to the drilling string. The swivel and kelly are then put back on the hook, hoisted out of the rathole, and connected to the top of the single just added to the drilling string.

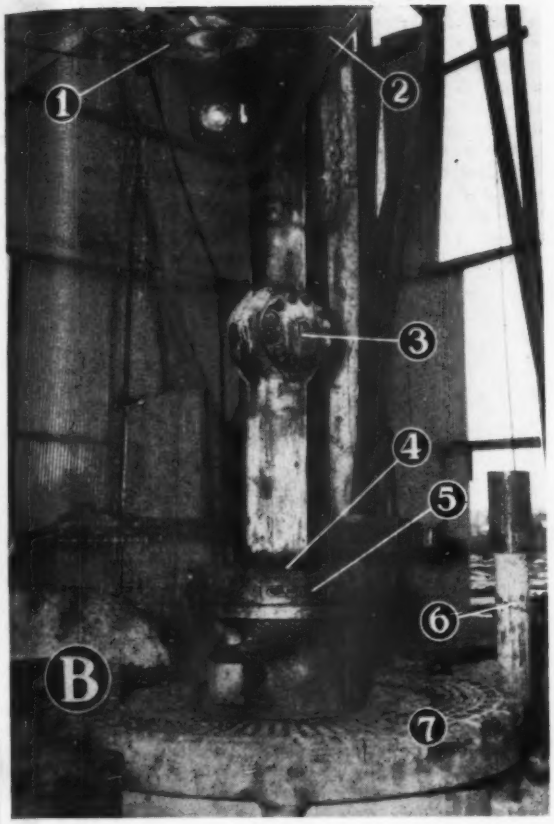
In big rotaries, time is saved by making a mouse-hole connection in which the single is added without taking the swivel and kelly off the hook.

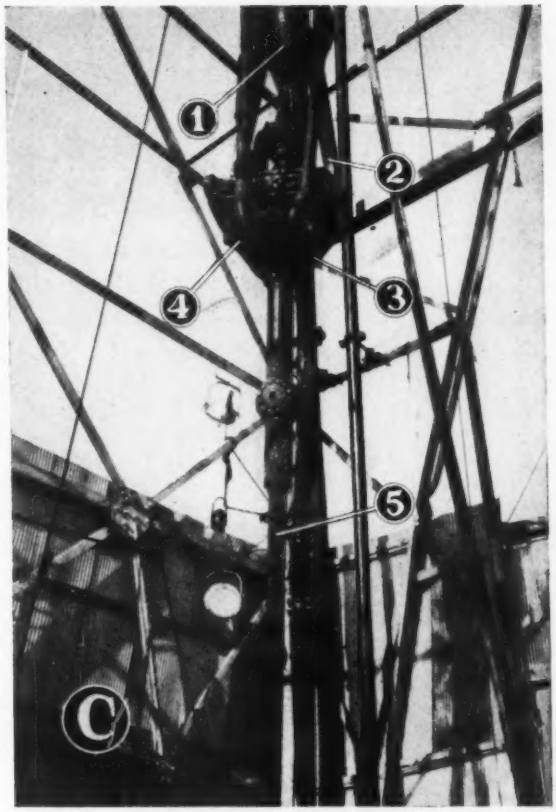
Accompanying drawings show various stages in making the mouse-hole connection. The single (the joint of drill pipe being added to the drilling string) is reproduced in color. The various pieces of rotary equipment depicted in the drawing are keyed by letter to the photos of the actual operations. Thus you have the step-by-step procedure in making the mouse-hole connection.



***A. DERRICK MAN AND ENGINE MAN** stab a single (1) into the mouse hole (2). This single is a 30-ft. joint of 5 9/16-in. drill pipe, weighing 725 lb. In the lower left corner of the photo is the rotary guard (3) which shows the position of the mouse hole in relation to the rotary table. The draw works is on the other side of the table. The mouse-hole cover (4) is placed over the mouse*







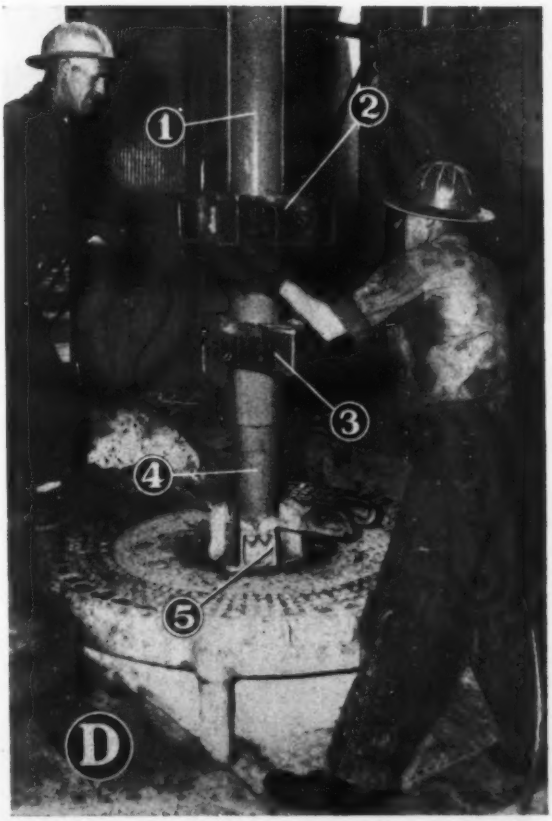
DRILLING OPERATIONS (Continued)

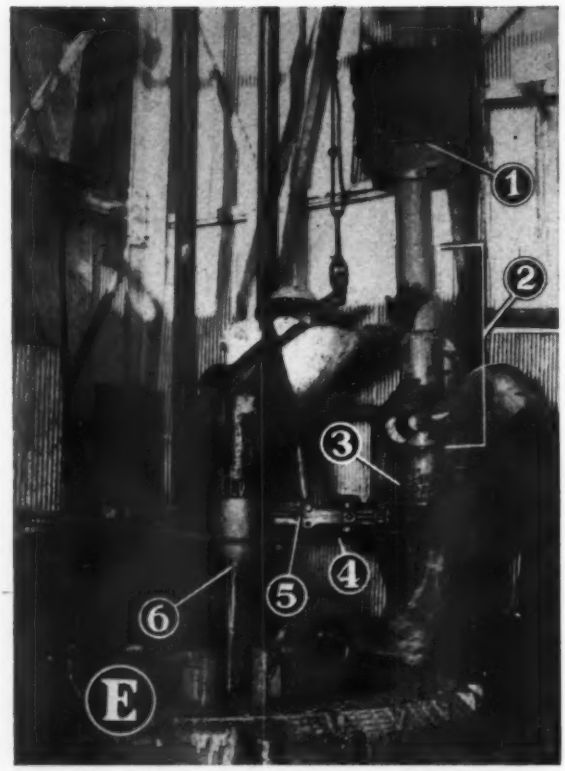
hole as a safety precaution when there is no single standing in the hole. The single is pulled in from the pipe rack, raised into position and lowered into the mouse hole by means of the cat line. This line, which is entirely independent of the traveling block, is used in handling the comparatively lighter tools and equipment on the rotary. The cat line is strung through a block at the top of the derrick. One end of the line is secured to the object to be lifted and the free end of the line is given several turns around the cathead on the draw works. The cathead man keeps tension on the free portion of the line so that the turns tighten around the revolving cathead for a friction grip. This causes the cat line to wind up on the cathead from the working end and unwind toward the free end. By holding just enough tension on the free portion of the line to keep the turns tight, the rotary helper utilizes the cathead on the draw works to transmit pulling power on the cat line in raising a heavy object. By slacking off the tension, the object can be easily lowered.

B. POSITION OF THE KELLY just prior to making a mouse-hole connection. The drill pipe elevator (1) hangs out of the way alongside the swivel (2). The kelly stopcock (3) is only a few feet above the rotary table and the working space of the kelly is entirely used up with only the top of the square section of the kelly barely visible at (4) above the kelly bushing (5). The top of the single (6) extends out of the mouse hole. The driller has shut off the power to the rotary table which is no longer revolving. The rotary guard (7) forms a stationary platform to provide a safe footing for rotary men working around the table.

C. DRILLING STRING BEING RAISED preparatory to disconnecting the kelly from the top joint of drill pipe. On the hook (1) hangs the swivel bail (2) which supports the swivel (3) and the kelly. The drill-pipe elevator is indicated by number (4), and (5) points to the working space of the kelly.

D. ROTARY HELPERS break out the kelly from the top joint of drill pipe. The rotary tong (2) is being latched in the breakout position around the saver sub (1) which forms the lower portion of the kelly. Like all seasoned "roughnecks" the men work





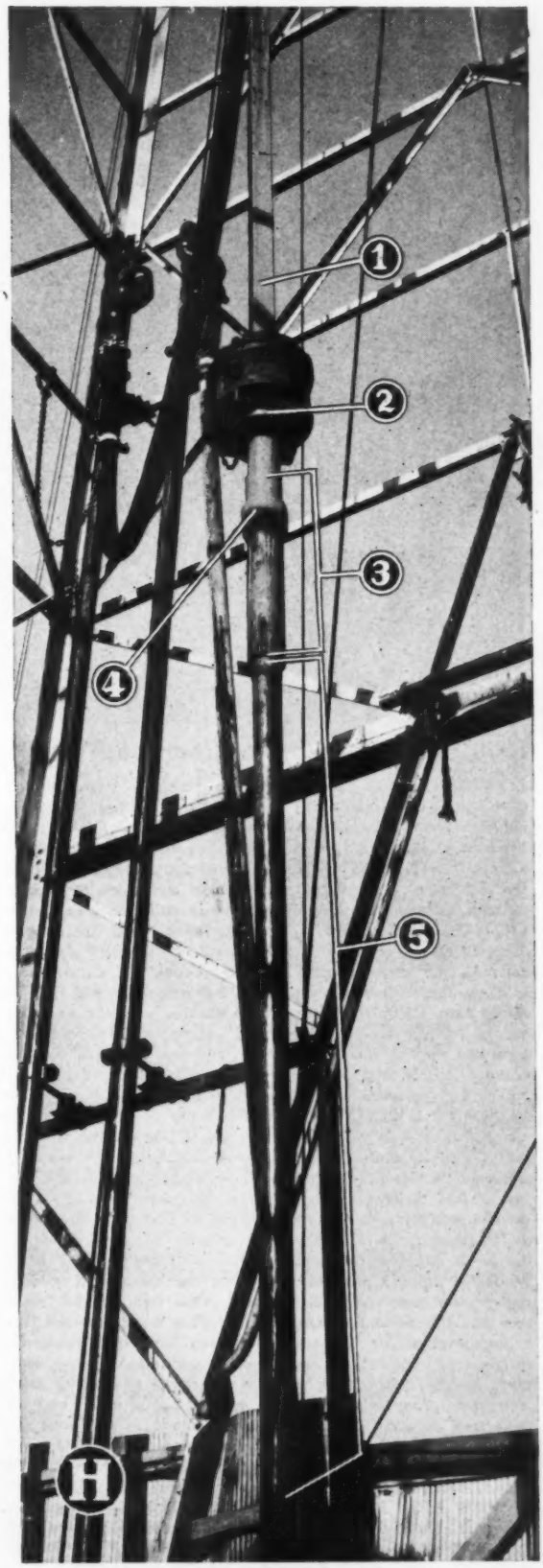
together with split-second timing. Note movement of hand of the man at right as he brings it up to "heel" the latch while the other man throws it shut. Latching of the other rotary tong (1) in the backup position around the tool-joint box on the top section of the drill pipe (4), has just been finished. Just prior to this operation as the drilling string was raised into its present position, the slips (5) were set in the opening in the rotary table around the drill pipe. The slips are three tapered pieces of steel so hinged that they can be placed around the drill pipe and slipped into the tapered seat of the rotary table opening. Thus, when the drilling string is taken off the hook, the slips form a tight wedge so that the rotary table supports the drilling string.

DRILLING OPERATIONS (Continued)

E. ROTARY FIREMAN AND ROTARY HELPERS have swung the kelly over and are stabbing it into the single in the mouse hole. Note the square shape of the kelly drive bushing (1) which fits into the square opening in the table, so that the rotary can revolve the drilling string when making hole. When the threads on the saver sub (2) have become worn or damaged, the sub can be broken out (unscrewed from the kelly) and replaced with a saver sub in good working condition. If this extra joint were not used and the kelly made up directly into the drill pipe, the entire kelly would have to be replaced from time to time as the threads become worn in making the numerous connections. The spinning chain (3) has been given several turns around the tool-joint box (top of the single). As pull is transmitted to the spinning line, the spinning chain will crawl up the saver sub, spinning the kelly rapidly so that it screws into the single for the connection. The spinning line (4) is attached to the spinning chain. The rotary tong (5) is in the backup position clamped around the tool joint box on the single to keep it from turning as the kelly is spun in. Extending a few feet above the table is the end of the top joint of drill pipe (6) in the drilling string.

F. CLOSEUP OF THE SAVER SUB (1) just as it has been stabbed into the single (4). Number (2) points to the forked swivel joining the spinning line to the spinning chain and the snap-up line. (The free end of the spinning line is given several turns around the revolving cathead, and by putting tension on the free end of the spinning line power is transmitted from the draw works to the spinning line in a manner similar to transmitting power to the cat line.) The other end of the snap-up line is attached to the arm of the rotary tong (3) so that when the tong is used in the makeup position and just at the instant the spinning line finishes its work, the snap-up line stretches taut with a pull on the tong to put a final turn on the pin joint for a tight connection. Number (5) points to the mouse hole and (6) the guard around the rotary table. Note that the spinning chain is so wrapped that the final turn is just even with the end of the tool-joint box on the single. The bottom turn of the chain is immediately above and resting on the jaws of the backup tong.

G. ROTARY HELPERS HOLD THE SPINNING CHAIN (2) in position as it spins the saver sub (1) of the kelly into the drill-pipe single (4). The jaws (3) of the rotary tong in the backup position firmly grip the single at the tool-joint box to keep it from turning. Note how the spinning chain has crawled up from the position shown in F. When the joint is as tight as the spinning chain will make it, the makeup tong in the lower right is swung into position and the joint is thoroughly tightened.



H. THE KELLY WITH SINGLE ADDED and coming out of the mouse hole just prior to swinging over the rotary table for connection to the drilling string. The lower portion of the working space of the kelly is seen at (1), the kelly drive bushing at (2), while (3) brackets the saver sub, and (5) the single. Number (4) points to the kelly saver-sub protector, a tough abrasion-resistant rubber collar which is slipped around the sub to protect the casing in the hole from undue wear or damage which might otherwise result from the sub slapping or rubbing against the inner wall of the casing. Similar tough rubber collars called drill-pipe protectors are placed around the drill pipe at regular intervals to protect the casing down the hole. These protectors are not used in the open (uncased) portion of the hole. A 30-ft. section of seamless steel drill pipe with a wall thickness of more than one-third of an inch appears to be a rigid piece of metal. However, when a hundred or more sections of drill pipe are made up, the drilling string becomes extremely flexible. The 250 singles of 4½-in. o.d. drill pipe that make up into a string of 7,500 ft. is comparable to a hollow steel wire 20 ft. in length, 12/100 of an inch in diameter, and with a wall thickness of 1/1,000 of an inch.

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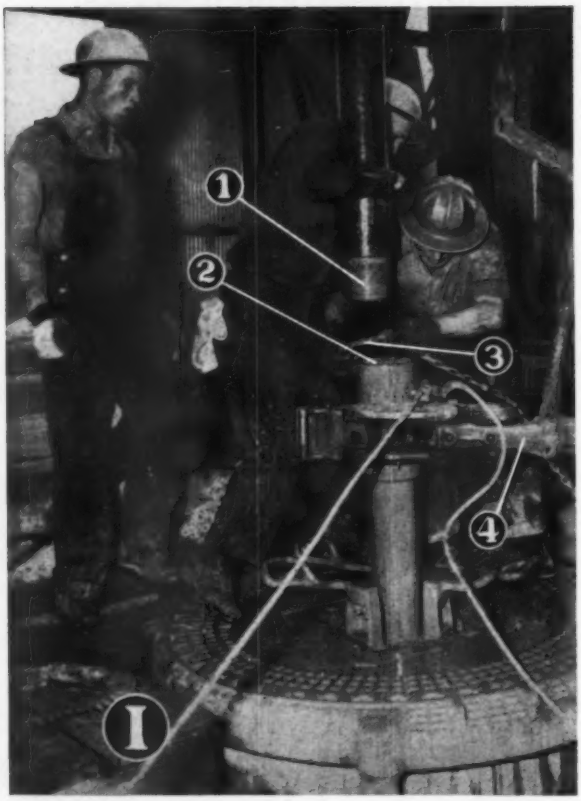
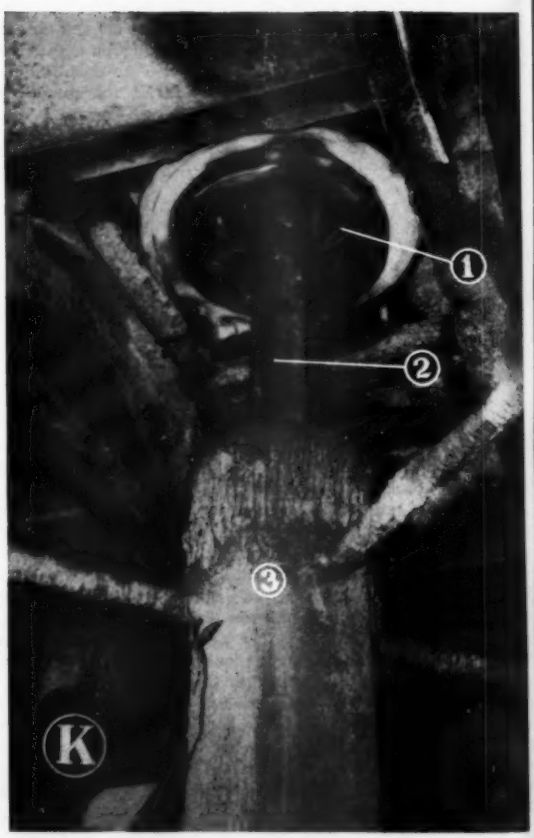


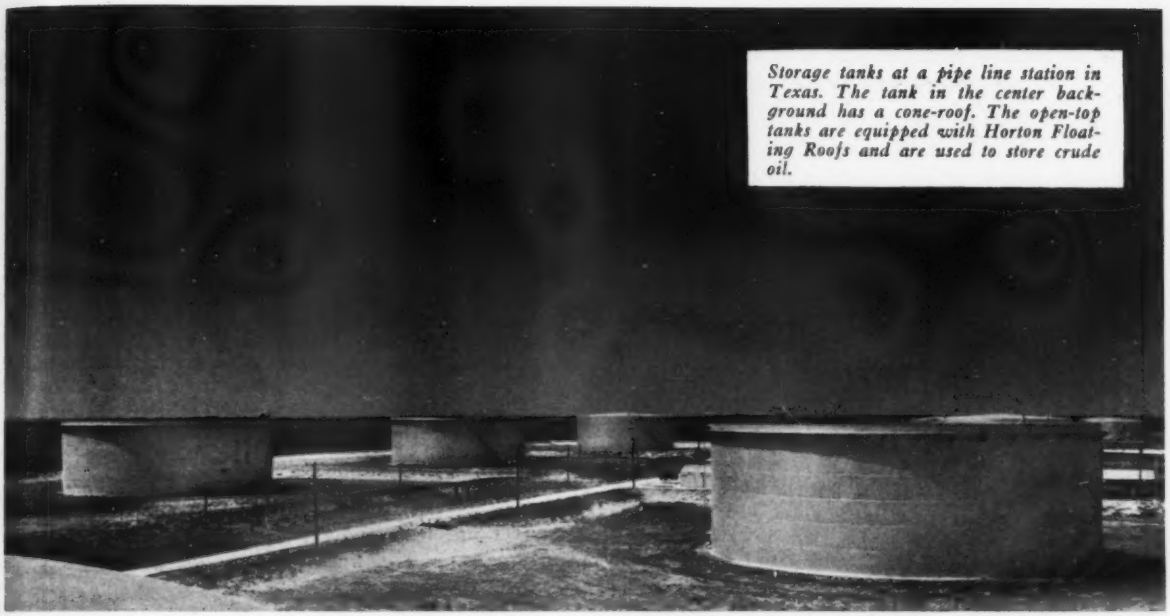
DRILLING OPERATIONS (Continued)

I. A ROTARY HELPER LINES UP the single to stab it into the drill pipe as another rotary helper starts his first turn of the spinning chain around the tool-joint box of the drill pipe. Working with perfect timing, the first man will stab the single with its threaded tool-joint pin (1) into the threaded tool-joint box (2) of the drill pipe, just as the second man completes the several turns of the spinning chain (3). This man will then give the free end of the chain a whip upward as the cathead and spinning line pull on the chain to spin the single into the drill pipe. (The action is the same as shown in G.) Meanwhile, as the single spins in, the third man shown standing to the left will slide the rotary tong (4) up into the makeup position with the tong jaws around the single. Then just as the spinning chain finishes its work the snap-up line will pull the tong arm clamping the jaws around the tool joint pin of the single and giving it a final turn for a tight connection into the tool-joint box of the drill pipe.

J. THE RIG IS CLEANED OF MUD that has spilled over in making the mouse-hole connection. The single has been added, slips pulled, and the drilling string lowered with the bit on bottom and making hole. Note the marks on the working surface of kelly (1). Just a few minutes before, these marks were brushed on the working surface with tool joint compound. The marks are placed at 1-ft. intervals and give the driller a quick count as to how fast the bit is digging (making hole) and also tell him the depth. While the primary purpose of tool-joint compound is to lubricate and protect the threads on the tool joints from galling, rotary men find this particular compound, because it contains red lead, a handy paint for temporarily marking tools and equipment. Number (2) points to the corner of the mouse-hole cover, which the crew has placed over the empty mouse hole as a safety precaution. The 10-in. casing (3) beveled on its upper end and projecting through the derrick floor, extends to the bottom of the "rathole." When it is necessary to come out of the hole with the entire drilling string to change bits or run casing, the kelly is lowered into the rathole and the hook disengaged.



K. VIEW FROM UNDERNEATH DERRICK FLOOR looking up at the under side of the revolving rotary table and kelly drive bushing (1). The kelly working space (2) extends down into the conductor pipe (3).



Storage tanks at a pipe line station in Texas. The tank in the center background has a cone-roof. The open-top tanks are equipped with Horton Floating Roofs and are used to store crude oil.

You have these choices for *crude* storage

When you are storing crude oil, it's to your advantage to prevent or reduce quality-destroying evaporation losses. If your tanks are filled and emptied *frequently*, your best bet is a **Horton* Floating Roof.** This efficient roof eliminates the vapor space by floating directly on the liquid in the tank. As a result, it stops filling losses, decreases standing storage losses, reuces the fire hazard, and cuts down corrosion on the underside of the roof.

You can cut down evaporation losses from standing storage tanks by using the **Horton* Vapordome Roof.** This roof has a flexible diaphragm in the dome section which allows the air-vapor mixture above the liquid to expand and contract without venting vapor to the atmosphere. The Vapordome can serve a single tank or it can be connected with several fixed-roof tanks to form a vapor-saving system.

Crude oil is sometimes stored in cone-roof tanks like the third from the left in the illustration at the top of this page. We recommend however that you use this type of tank—not for crude oil—but for storing fuel oil or other petroleum products of low volatility. Excessive evaporation losses of the more volatile components occur when most crudes are stored in cone-roof tanks.

What type of Horton* structure is best for *your* purposes? Let our experienced representatives select the right one for you.

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Right: 20,000-bbl. tank equipped with a Horton Vapordome Roof in Texas. It is connected to three 10,000-bbl. fixed-roof tanks by the vapor line shown in the foreground. The Vapordome tank is thus the central unit of a vapor-saving system.

96,000-bbl. crude oil storage tank equipped with a Horton Floating Roof at a tank farm in Pennsylvania.

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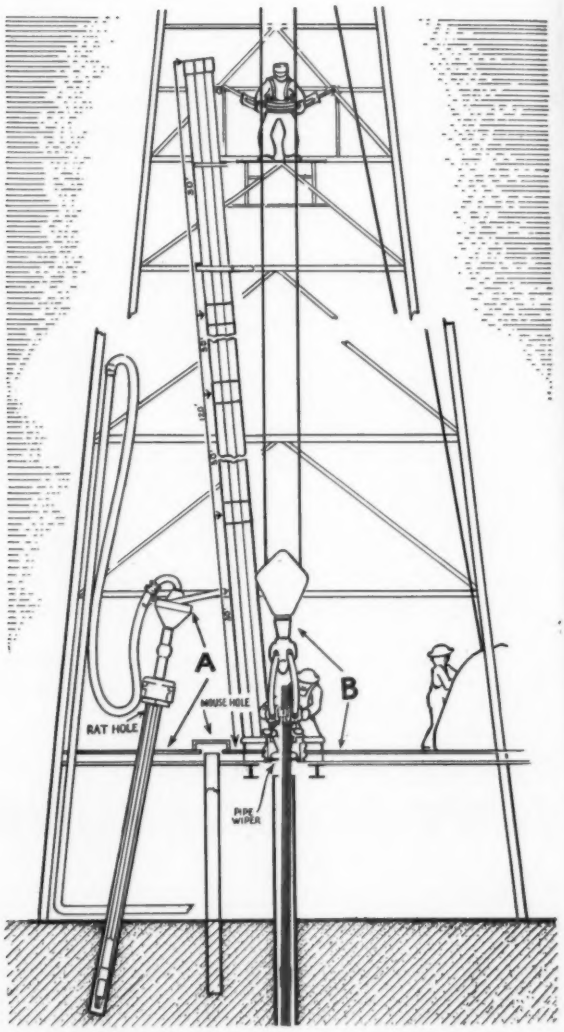
Pulling Drill Pipe

IN rotary drilling it is necessary to pull the drilling string from the hole from time to time. This is done for a number of reasons, some of which are: to change bits when the old ones become worn or out of gage; to run casing to shut off a troublesome water sand; or to stop and make a test of a formation.

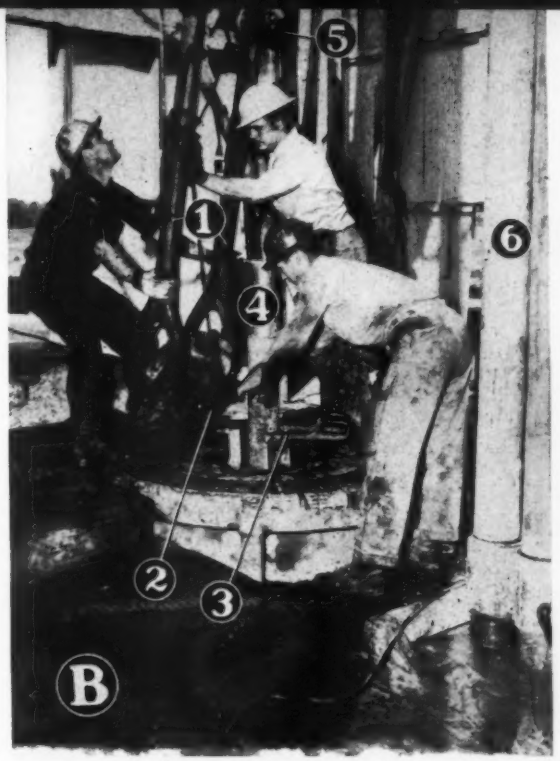
In the early rotaries and still practiced on small rotaries drilling to a shallow depth, the drill pipe is broken apart at every section, a single, or every other section, a "double," and racked (stood up) on the derrick floor. On the larger rotaries, time is saved by breaking the drill pipe every three sections, thribles; while on the largest type rotaries, such as this one, with a 192-ft. derrick and plenty of working space, more time is saved by breaking apart drill pipe every fourth section, a fourble.

The diagrams and action photographs give the step-by-step procedure in pulling the drilling string, and breaking and racking drill pipe into fourbles.

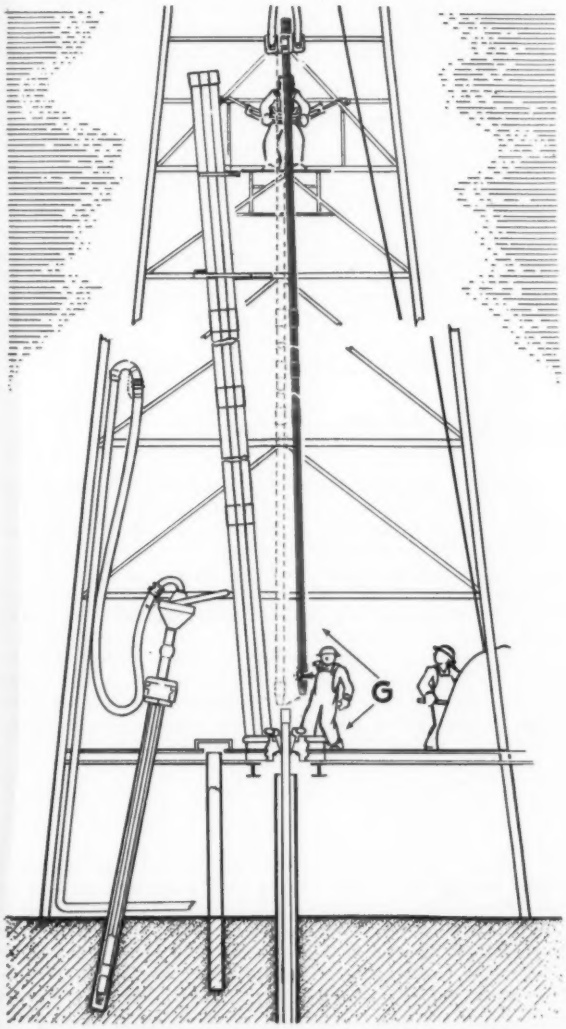


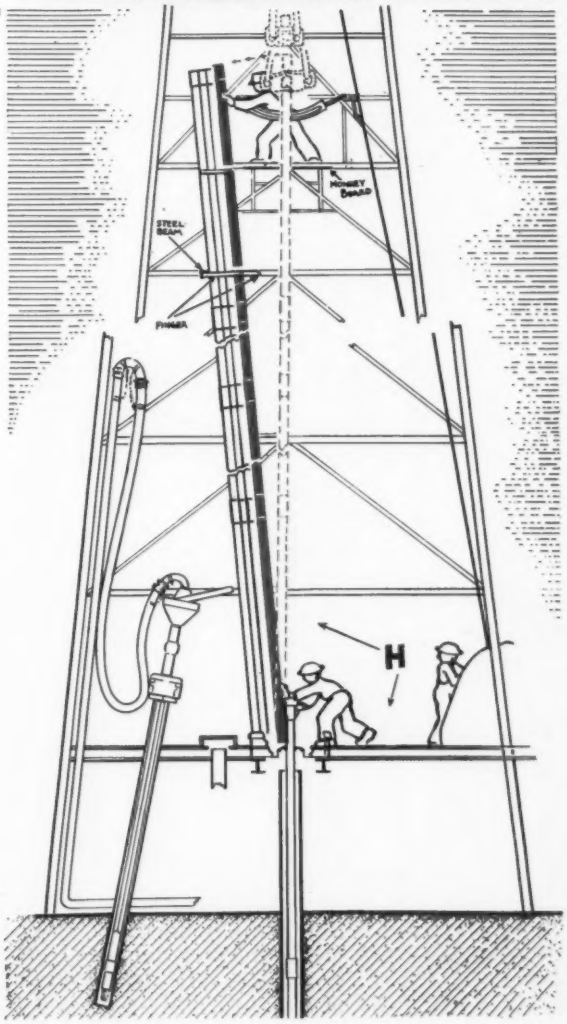
PULLING DRILL PIPE (Continued)

A. OFF THE HOOK.—The swivel and kelly are removed and out of the way in the rathole. Number (1) identifies the swivel while (2) is the kelly drive bushing which rests on the end of the 10-in. casing (3) extending through the derrick floor to the bottom of the rathole. The kelly saver sub and working space of the kelly have been stabbed into the rathole. The kelly was broken out from the top joint of drill pipe (4) in the drilling string exactly as in making a mouse-hole connection.



B. DRILL-PIPE ELEVATOR is swung into place to latch onto the top fourble in the hole. A fourble is four sections of drill pipe. Two men have hold of the elevator links (1) while another has a firm grip on the drill-pipe elevator latch (2) ready to close it as the elevator is placed around the drill pipe immediately below the tool-joint box (4). The tool-joint box will shoulder against the closed elevator to secure the drilling string as it is raised from the hole prior to pulling and resetting the slips (3) and breaking out the fourble. Note the kelly (5) standing in the rathole, while (6) shows the lower portions of fourbles that have been broken out of the drilling string and racked (stood up) on the derrick floor and behind the finger up derrick.





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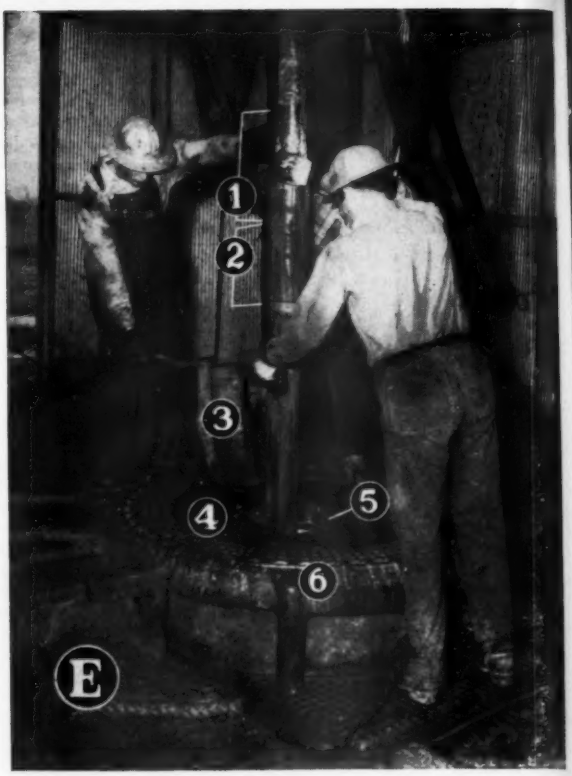

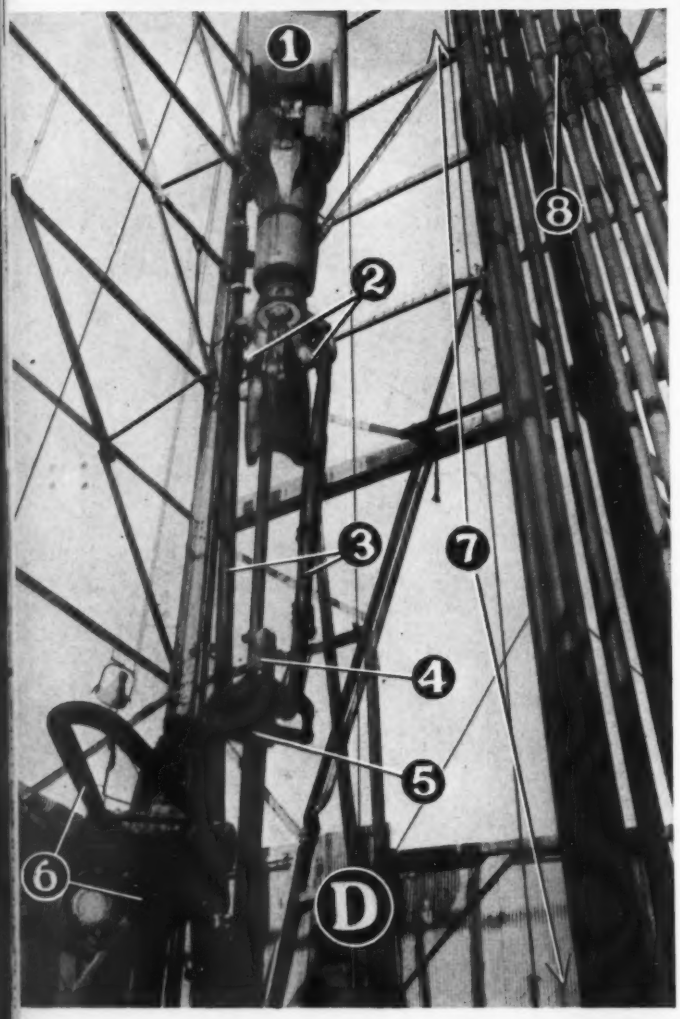

PULLING DRILL PIPE (Continued)

C. MEN HOLD SLIP HANDLES ready to pull the slips as driller at the driller's post (not shown in the photo) works the various controls on the draw works to hoist approximately 122 ft. of the drilling string up derrick (four sections of 30-ft. drill pipe which make up the fourble to be broken out plus a few feet of the top joint of drill pipe in the hole). Slips will then be replaced (photo E) around the drilling string and dropped into the rotary-table opening to support the string while the fourble is broken out (unscrewed).

D. GOING UP, PLEASE!—Taken from behind the rathole, this photo catches the block (1) and hook traveling up derrick. Number (2) points to the ears of the hook which hold the elevator links (3). The tool-joint box (4) shoulders on the drill pipe elevator (5) which is latched around the top joint of drill pipe thus supporting the drilling string. Number (6) points to the swivel bail, swivel, and top portion of the kelly standing in the rathole and out of the way. Number (7) brackets the lower portion of the several fourbles that have been racked; (8) points to a drill-pipe stabilizer, tough, abrasion-resistant rubber collars placed around the drill pipe at various intervals to protect the casing from damage during operation as the drilling string is rotated.

E. TOOL JOINT DETAILS.—Slips are lowered into the rotary-table opening just as driller at the draw works controls stops the traveling block near the top of the derrick. Thus the entire drilling string is raised approximately 122 ft. and the crew is ready to break out another fourble. Number (1) brackets the tool-joint pin of the upper section of drill pipe and number (2) brackets the tool-joint box of the lower section of drill pipe. (See diagram

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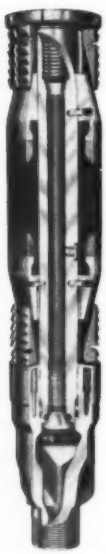

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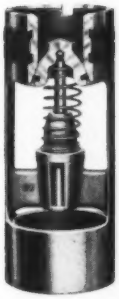

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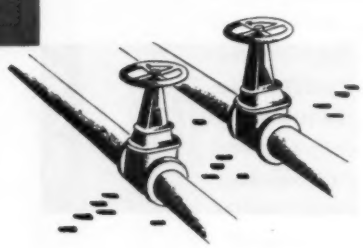

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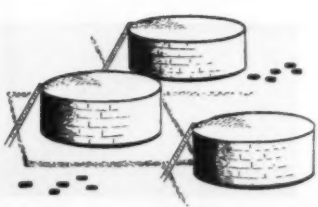

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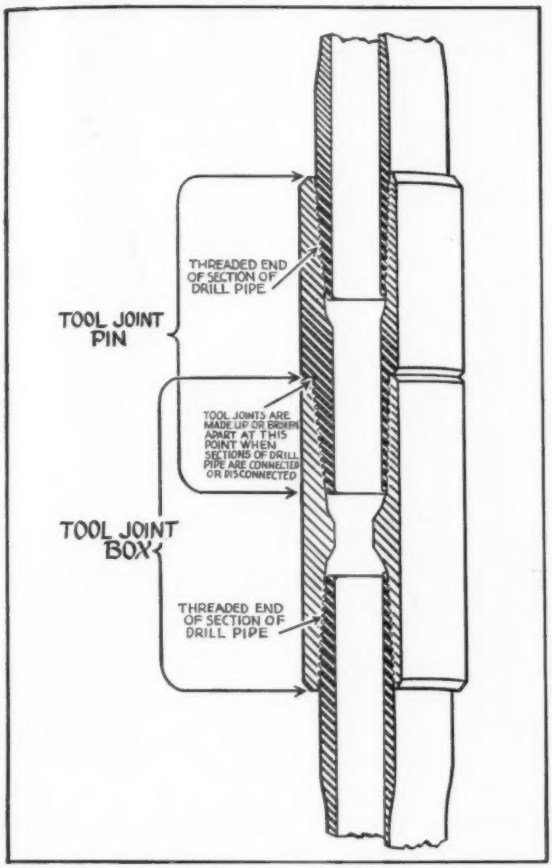
THREADED END OF SECTION OF DRILL PIPE
TOOL JOINT PIN
TOOL JOINTS ARE MADE UP OR BROKEN APART AT THIS POINT WHEN SECTIONS OF DRILL PIPE ARE CONNECTED OR DISCONNECTED
TOOL JOINT BOX
THREADED END OF SECTION OF DRILL PIPE

PULLING DRILL PIPE (Continued)

for detail.) At the point where the brackets converge in photo E the tool joints will be broken apart. The tool joints serve the same purpose as the kelly saver sub. When the threads of the tool joints become galled, damaged, or worn, they may be repaired or replaced. If the sections of drill pipe were screwed together directly, as is done with casing or line pipe, the entire section of drill pipe would have to be replaced or rethreaded frequently, as the threads become worn from the many times the drilling string is made up or broken apart. The tool joints are heated, then immediately screwed onto the threaded ends of the section of drill pipe. As the joints rapidly cool, they shrink to form an exceedingly tight connection. The tool-joint box (see diagram) forms the top end of the section of drill pipe while the tool-joint pin forms the bottom end of the section of drill pipe. The threaded end (see photo G, number 2) of the tool-joint pin screws into the tool-joint box as one section of drill pipe is connected to another. Men have hold of the handles of the drill-pipe slips (3) lowering it into the opening (5) of the rotary table (4). Number (6) identifies the stationary rotary guard. With a nonskid surface, the rotary guard furnishes a safe footing and protection for men working around the table while it is rotating.

F. TONGING OPERATION.—The rotary tong (1) is latched in the breakout position around the tool-joint pin of the bottom section of drill pipe in the fourble (the four sections of drill pipe which now extend up derrick and are supported by the drill-pipe elevator on the hook). One man swings the rotary tong (2) in the backup position where it will be clamped around the tool-joint box of the section of drill pipe extending a few feet above the rotary table. With the tong jaws clamped tight, a pull will be put on the arm of the tong (1) via the tong line and breakout cat head at the draw works. Thus as the backup tong (2) holds the drilling string from turning, the fourble is given a partial turn to break the tool joints. To complete the operation of breaking out the fourble, the back-up tong (2) is unlatched, swung out of the way, and the rotary table revolved. The tong (1) now holds the fourble from turning while the rotary table spins the drilling string unscrewing it from the fourble. The slips (3) form a tight wedge around the drilling string to revolve the string with the table and to support its entire weight as it is disconnected from the fourble supported by the elevator and hook.

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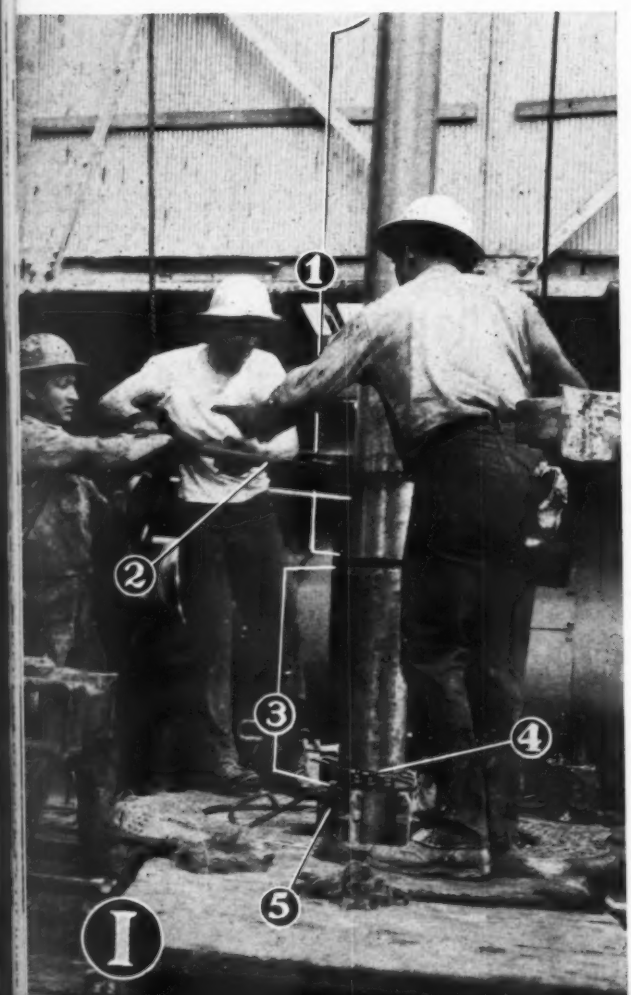
G. FOURBLE is worked back from the center of the derrick floor to get it into position to rack the fourble (stand it on the derrick floor). Note the drill-pipe hook (1) which is used. Number (2) points to the threaded end of the tool-joint pin on the bottom section of drill pipe in the fourble. Short lengths of rope (3) are nailed to the derrick floor to provide a secure footing for walking the fourble into position and racking it. The other end of the fourble is supported some 124 ft. up derrick by the drill-pipe elevator on the hook. The racked fourbles are supported with their tool-joint ends (4) resting on the derrick floor.



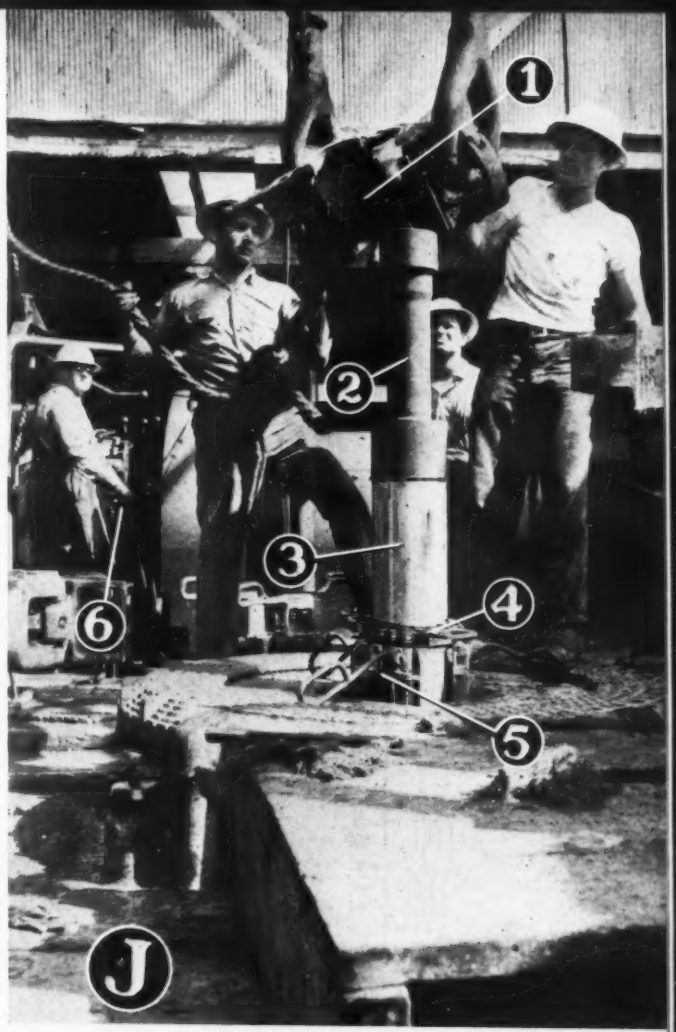
PULLING DRILL PIPE (Continued)

H. SHOVING LOWER END OF FOURBLE into position. Note the hard hats these men wear. Not unlike World War I helmets in shape, but of considerably lighter material, they are a must when on the derrick floor and reduce to the minimum accidents from falling or swinging objects. Gloves are also worn as protection against rope burns, wire splinters, or cuts from sharp edges of rotary equipment and tools. Note safety shoes. These shoes, built with a steel cap across the toes, have saved many a rotary man's foot when a heavy piece of equipment was inadvertently dropped. Meanwhile, the derrick man with a safety belt around his middle and standing on the monkey board, 120 ft. up derrick (see diagrams at the start of this section) grasps the upper section of the fourble and guides it around the finger as man on the floor walks the fourble back. With the fourble leaning against the finger and as the driller at the controls starts the elevator down, derrick man unlatches the elevator from the fourble, and the block, hook, and elevator are lowered for another trip (the complete operation in breaking out and racking a fourble). Within the few seconds the elevator is lowered and latched onto the drill pipe extending out of the rotary table, the derrick man with an accurately timed motion swings the upper portion of the fourble away from the finger and into its place with the racked fourbles. The finger, a steel beam, extends from the side of the derrick to a point just cleared by the traveling block. Located a short distance below the monkey board, the finger serves as a support against which the fourble is leaned until the elevator is unlatched. A steel beam at right angles to the finger furnishes the vertical support for the racked fourbles. The first row of racked fourbles lean against this beam. (An accompanying diagram shows the position of the finger, beam, and monkey board.)

I. BREAKING OUT.—All the drill pipe has been pulled from the hole broken into fourbles, and racked. A portion of the fourbles is seen immediately in back of the man on the left. The crew is now breaking out the drill collars. Thicker walled than the drill pipe, the drill collars are placed at the bottom of the drilling string immediately above the bit. With this weight

PULLING DRILL PIPE (Continued)

concentrated in the drill collars just above the bit, vibration of the drill pipe during drilling is reduced to a minimum, so that the danger of the drill pipe twisting off (breaking in two) is largely avoided. Number (1) brackets a drill collar being broken out. The men are using the chain tong (2) to "walk out" (unscrew by manpower) the drill collar. Number (3) brackets the portion of a drill collar extending out of the rotary table. The outside wall of the drill collars used for this well is flush. There are no shoulders on the ends of these drill collars as are formed by the tool joints on the ends of sections of drill pipe. So, in good rotary practice a drill-collar safety clamp (4) is made secure around the drill collar to prevent the drill collars from dropping to the bottom of the hole, causing a time-consuming and costly fishing job should the drill-collar slips (5) fail to hold. After the drill collar is broken out, it will be hoisted up a few feet, swung to the side of the derrick opposite the fourbles, and racked on the derrick floor.



J. READY TO LATCH DRILL-PIPE ELEVATOR, item (1), around the drill collar handling sub (2), prior to hoisting the last drill collar (3) and the rock bit out of the hole. Of the same shape and size as the end of a section of drill pipe, the drill collar handling sub is screwed into the drill collar as a means of attaching the elevator for a positive grip. The safety clamp (4) and slips (5) will be removed after the elevator is made secure. Driller at the draw-works controls with his hand on the transmission clutch lever (6) will lower the elevator into position, then raise the drill collar and bit out of the hole after the elevator is latched around the sub.

K. BIT IS EXAMINED as it comes out of the hole. Number (1) points to the drill pipe wiper, a tough rubber collar which rides around the drill pipe and against the underside of the rotary table, so that as the drilling string is pulled out of the hole the rubber collar wipes the drilling string clean of mud. Number (2) indicates the cutter supports of the bit and (3) the teeth and cutters of the rock bit. Number (4) points to the square opening in the rotary table with the table bushing removed to allow the bit to come through.

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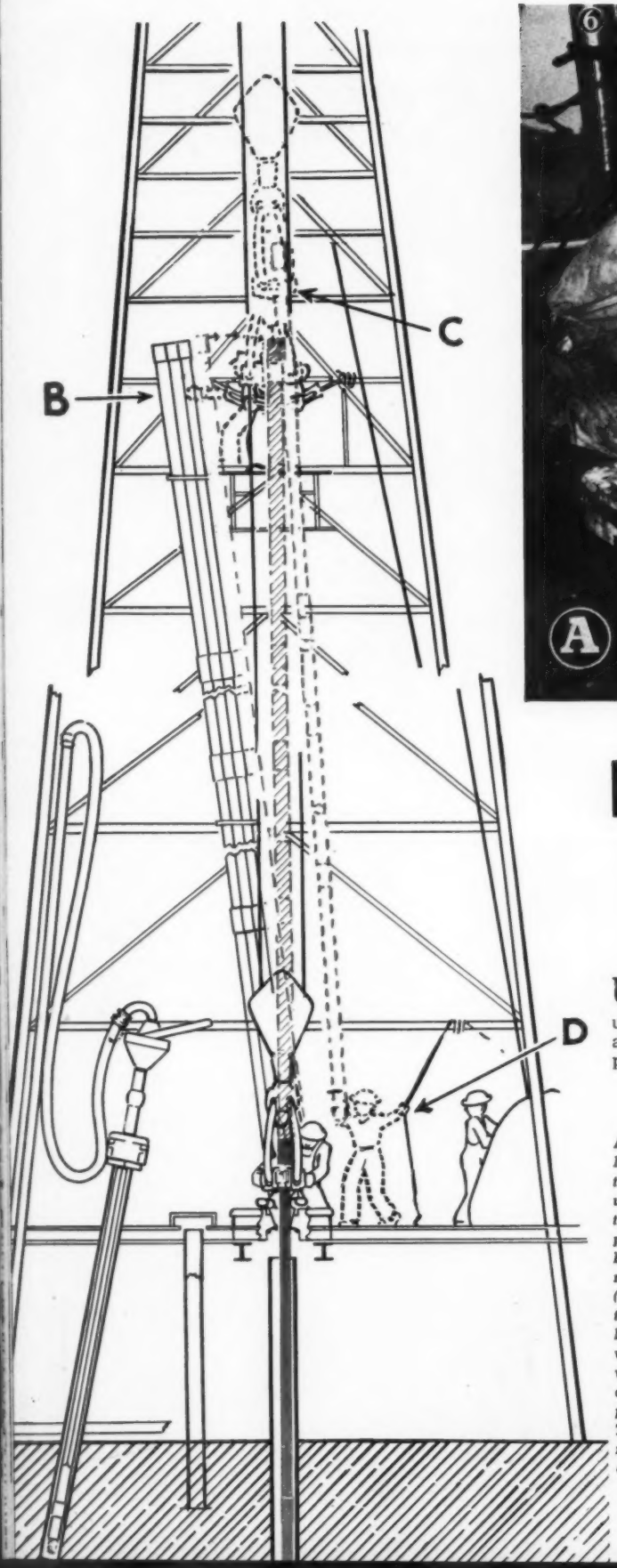

Back Into The Hole

UNPOSED action closeups are presented of the derrick man at work on the monkey board located 120 ft. up derrick, the height of a 10-story building. Photos and diagrams take the reader through another action-packed procedure, "going back into the hole."

A. GOING DOWN, PLEASE! *Rotary fireman and derrick man line up the drill collar and new hard-rock bit to stab the bit into the bit breaker. Number (1) and (2) label the halves that make up the rotary-table bushing, which has been removed to allow the bit to go through. (While drilling, the rotary-table bushing is placed in the square opening of the table, and the kelly drive bushing fits into the rotary-table bushing; so that as the table rotates, the entire drilling string is rotated with it.) The bit breaker (3) is temporarily placed in the square opening of the rotary table. The bit (4) which has been spun into the drill collar (5) by hand will be lowered into the bit breaker. Driller at the draw-works controls will lock the rotary table to keep it from rotating while rotary helper and derrick man will clamp the rotary tong around the drill collar in the makeup position and a pull will be put on the tong line and makeup cat head at the draw works. Thus as the bit is held from turning by the breaker in the locked rotary table, the drill collar will be given a final turn to make a tight connection onto the bit. Number (6) labels a racked drill collar.*

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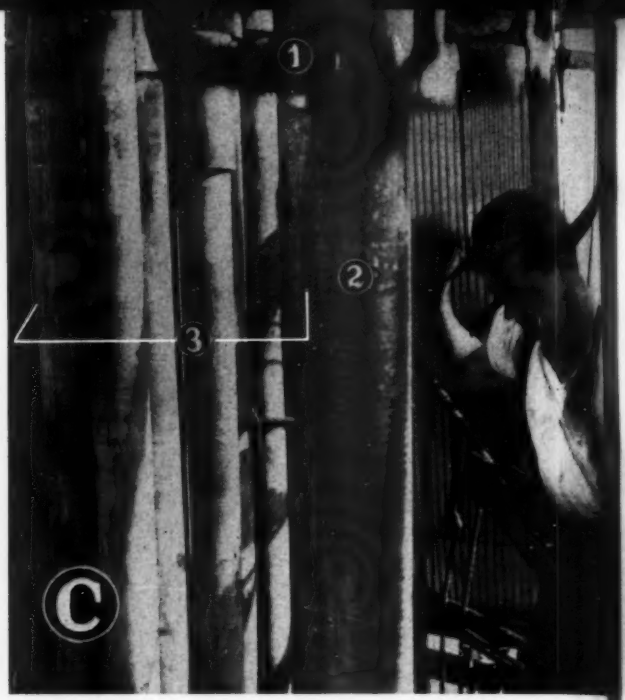

BACK INTO THE HOLE (Continued)

B. ACTION STARTS AGAIN. With the bit and drill collars made up into the drilling string, the crew adds the fourbles of drill pipe to the drilling string. Derrick man is on the monkey board, 120 ft. up the derrick. Number (1) points to a portion of the safety ladder which he climbed to reach his perch; (2) points to the rope and one of the shoulder straps of the derrick man's safety harness. The rope is fastened to the derrick and to the back of the belt of the safety harness. This forms a positive safety device to prevent his falling to the derrick floor in an extreme case of the belly-buster (3) across his middle giving way. Man stands on the monkey board (4). Just prior to the operation shown in this and the next photo, men on the derrick floor unlatched the drill-pipe elevator from the drill pipe set in the slips in the rotary table, and turned the elevator so that the elevator latch would face the derrick man in traveling up derrick. At the instant the elevator was unlatched and faced, driller at the draw-works controls threw the clutch to send the block, hook, and empty elevator speeding up derrick. Meanwhile, derrick man had swung the upper portion of the next fourble to be worked from its row in the racked fourbles out onto the finger and directly in line with the path the elevator travels. Derrick man then pushed on the lines of the block as it moved up derrick to steer the block, hook, and empty elevator past the finger. The elevator (6) was then swung in, so that he could grasp it on the fly and throw the elevator latch (5) shut to lock the moving elevator around the fourble (7). Number (8) identifies one of the elevator links.

C. UP IN THE DERRICK.—Next phase of this continuous action catches the derrick man. In photo he has moved his hands out of the way, after latching elevator (1) which locked around the fourble (2). The elevators in moving up, lift against the tool-joint box of the top section of drill pipe, and raise the fourble off the derrick floor. Number (3) brackets the upper portion of the fourbles still racked. Driller works the brakes stopping the upward travel of the fourble when it is high enough to swing into position over the drill pipe setting in the slips, as shown in the next photo.

D. DOWN ON DERRICK FLOOR.—Rotary fireman holds to the rope (1) and with his pipe hook (2) walks the fourble into position, so that engine man can stab it into the drill pipe projecting out of the rotary table. In the 15 seconds that the more than 9 tons of block, hook, links, and elevator traveled 125 ft. up derrick, the rotary helper had wrapped the spinning chain (3) around the tool-joint box of the top section of drill pipe in the hole, while engine man had placed the tong (4) in the preliminary makeup position. Number (5) points to the drill-pipe slips which form the wedge between the drill pipe and rotary table to support the drilling string during this phase of the operation. The fourble will be spun into the drill pipe in a similar manner as the kelly was spun into the single in making a mouse-hole connection. Number (6) brackets the lower portion of the fourbles on the rack.

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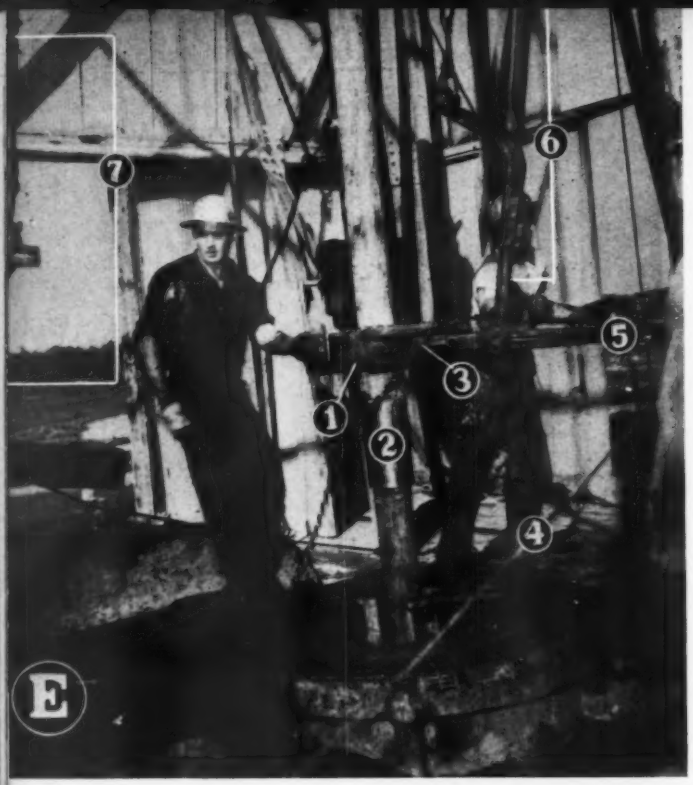
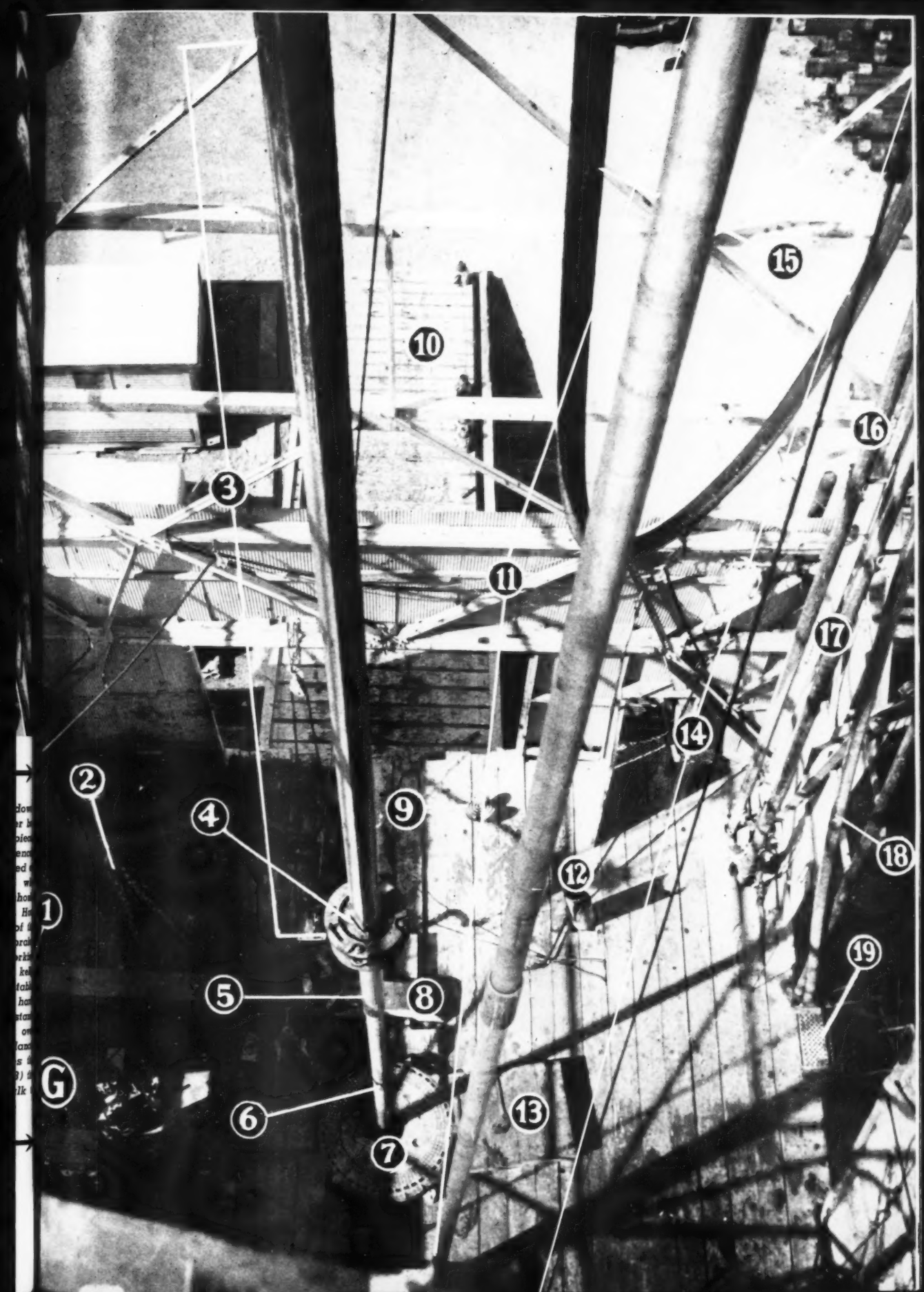


BACK INTO THE HOLE (Continued)

E. MAKING UP FOURBLE.—The spinning chain has just finished its work of spinning the fourble into the drilling string. Engine man has shoved the tong (1) up from the preliminary position on the tool-joint box (2) to the final makeup position around the tool-joint pin of the lower section of drill pipe in the fourble. Engine man now throws the latch to lock the tong (1) while rotary helper pulls the spinning chain (3) across tong so that it will be in a ready position to wrap around the next fourble to be spun in. The tong line (4) attached by the swivel joint to the spinning line will within a split second tighten as the cathead man puts additional tension on the free end of the spinning line wrapped around the revolving cathead at the draw works. Thus the tong arm (5) will be pulled clockwise turning the fourble for a tight connection into the drilling string, which is held from turning by the locked rotary table. Numbers (6) and (7) bracket the gooseneck hangers and the counterweight lines on which the rotary tongs, weighing 415 lb. each, are suspended for ease in handling. The rotary tong at (7), not used in this operation, is swung out of the way.

F. ADDING DRILL PIPE.—With the fourble made up into the drilling string, driller raises the string a short distance, so that engine man and rotary helper can pull the slips. Driller then lowers the drilling string approximately 120 ft. into the hole preparatory to the adding of another fourble. Number (1) points to the wire cable strung through the traveling block and the crown block at the top of the derrick. The cable unwinds from the hoisting drum in the draw works as the block (2) is lowered. Number (3) identifies the shank of the hook while (4) identifies the ears of the hook on which are suspended the elevator links (5). Number (6) points to the tool-joint box of the top section of drill pipe which shoulders against the elevator (7). Number (8) brackets a portion of the racked fourbles.

G. HOW MANY CAN YOU NAME?—(Opposite page). A doz derrick shot taken from the first safety platform on the ladder b low the monkey board, is exceptional for the number of pie of rotary equipment and tools clearly shown. An experien rotary man can identify at least six more than are numbered the photograph while those outside the rotary field but w have carefully read the preceding on Deep Rotary Drilling sho be able to name 15 of the 19 numbered parts of the rotary. H many can you identify? Number (1) points to the housing of t hoisting drum on the draw works and the hydromatic bra (2) the safety anchor for the backup-tong line, (3) the work space of the kelly, (4) the kelly drive bushing, (5) the k saver sub, (6) the top section of drill pipe, (7) the rotary ta (8) the safety guard covering the rotary chain drive, (9) a h rock bit, (10) the ramp to the derrick floor, (11) a fourble st ing racked and not in use, (12) the rat hole, (13) the cover o the mouse hole, (14) a tong line connecting to the counterbala (15) the rotary mud hose, (16) the standpipe which carries t mud to the hose, (17) the standby (auxiliary) standpipe, (18) t standby mud hose, and (19) the safety stairs from walk derrick floor.



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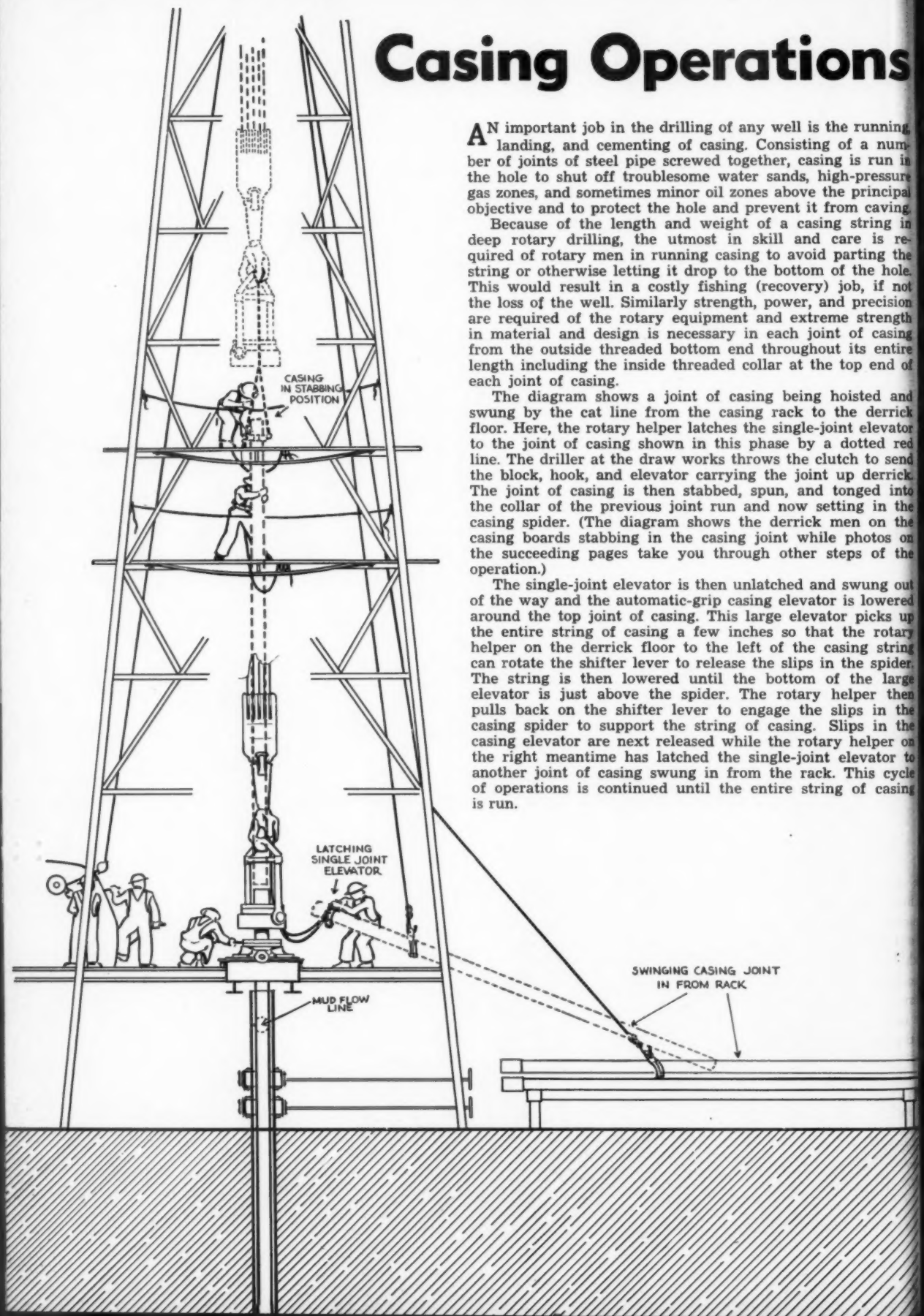
Casing Operations

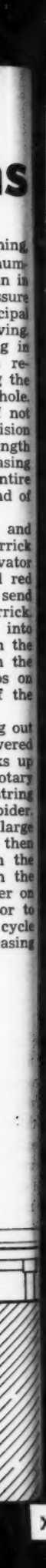
AN important job in the drilling of any well is the running, landing, and cementing of casing. Consisting of a number of joints of steel pipe screwed together, casing is run in the hole to shut off troublesome water sands, high-pressure gas zones, and sometimes minor oil zones above the principal objective and to protect the hole and prevent it from caving.

Because of the length and weight of a casing string in deep rotary drilling, the utmost in skill and care is required of rotary men in running casing to avoid parting the string or otherwise letting it drop to the bottom of the hole. This would result in a costly fishing (recovery) job, if not the loss of the well. Similarly strength, power, and precision are required of the rotary equipment and extreme strength in material and design is necessary in each joint of casing from the outside threaded bottom end throughout its entire length including the inside threaded collar at the top end of each joint of casing.

The diagram shows a joint of casing being hoisted and swung by the cat line from the casing rack to the derrick floor. Here, the rotary helper latches the single-joint elevator to the joint of casing shown in this phase by a dotted red line. The driller at the draw works throws the clutch to send the block, hook, and elevator carrying the joint up derrick. The joint of casing is then stabbed, spun, and tonged into the collar of the previous joint run and now setting in the casing spider. (The diagram shows the derrick men on the casing boards stabbing in the casing joint while photos on the succeeding pages take you through other steps of the operation.)

The single-joint elevator is then unlatched and swung out of the way and the automatic-grip casing elevator is lowered around the top joint of casing. This large elevator picks up the entire string of casing a few inches so that the rotary helper on the derrick floor to the left of the casing string can rotate the shifter lever to release the slips in the spider. The string is then lowered until the bottom of the large elevator is just above the spider. The rotary helper then pulls back on the shifter lever to engage the slips in the casing spider to support the string of casing. Slips in the casing elevator are next released while the rotary helper on the right meantime has latched the single-joint elevator to another joint of casing swung in from the rack. This cycle of operations is continued until the entire string of casing is run.





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CHAPTER FOUR in the Fascinating Story of the Search for Oil

In 1913 With the acceptance of geology by the oil industry as a guide to prospecting, the technique of first importance to the industry became that of surface structural mapping . . . of a hunt for surface anticlines. About the year 1913, however, detailed surface mapping with the plane table—taken over from the topographic branch of the United States Geological Survey by W. T. Griswold in mapping the Cadiz, Ohio, quadrangle—became the order of the day. By the middle 20's, practically all of the areas regarded as attractive for oil prospecting in the Mid-Continent had been mapped and the method had practically exhausted its usefulness. From E. DeGolyer's Book, *"The Development of the Art of Prospecting."*

In 1950 Specialized seismograph equipment used today in the continuing search for new oil reserves has evolved from years of laboratory and field work by geologists and physicists . . . by mechanical, electrical and electronic engineers . . . by hundreds of practical men with an inbred aptitude for petroleum exploration. Still, exhaustive work and study go on in an effort to further improve present equipment. In General Geophysical laboratories, scientists and engineers design and build every piece of equipment used by General field crews. Other technicians are investigating theories advanced for the development of new specialized equipment. That's why General is better equipped today than ever before to accurately locate and determine conditions favorable to finding new oil reserves.

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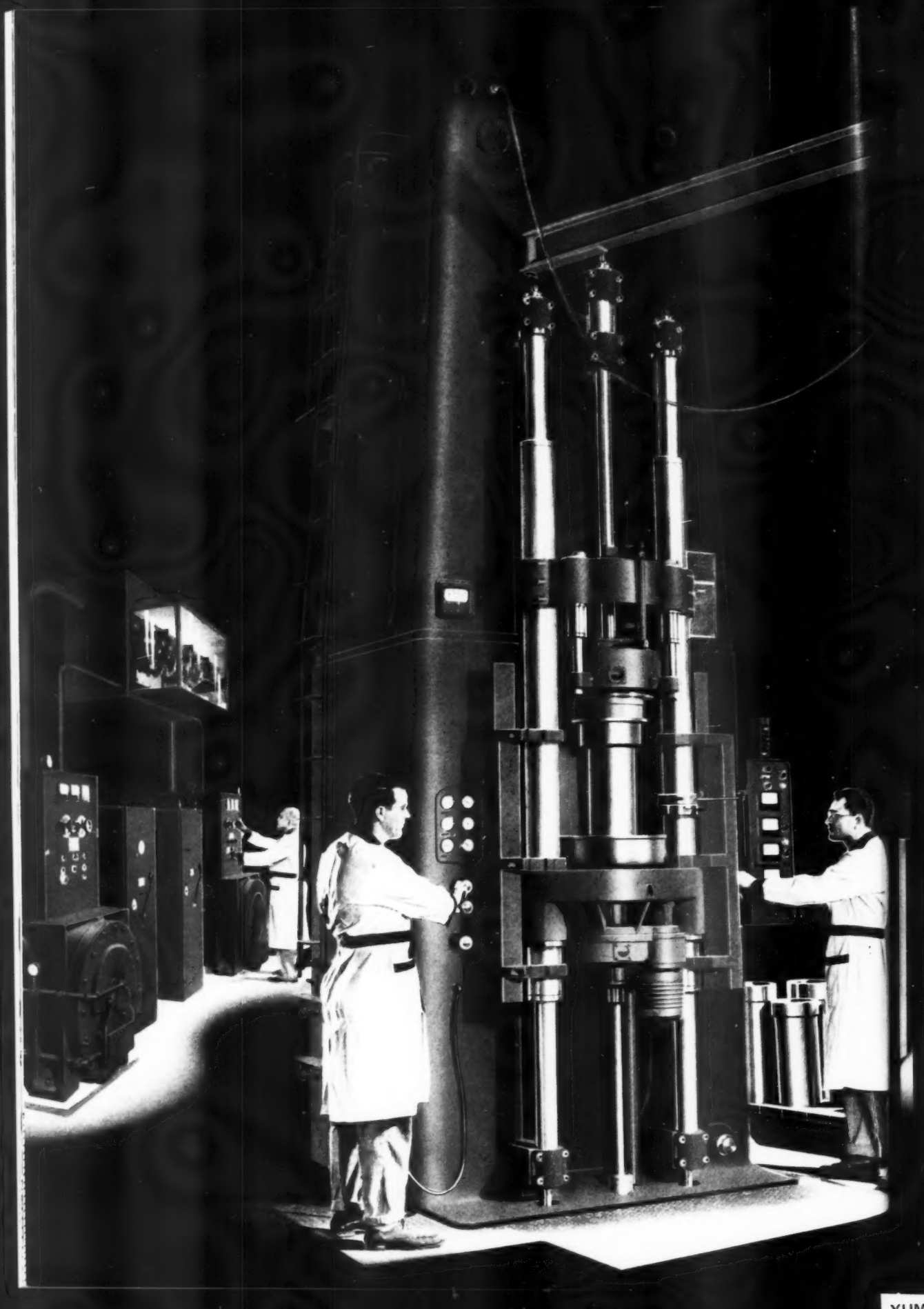

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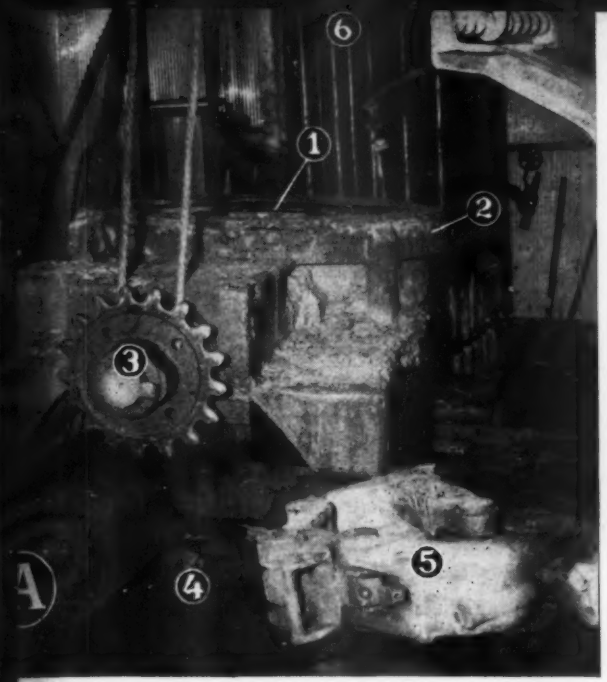
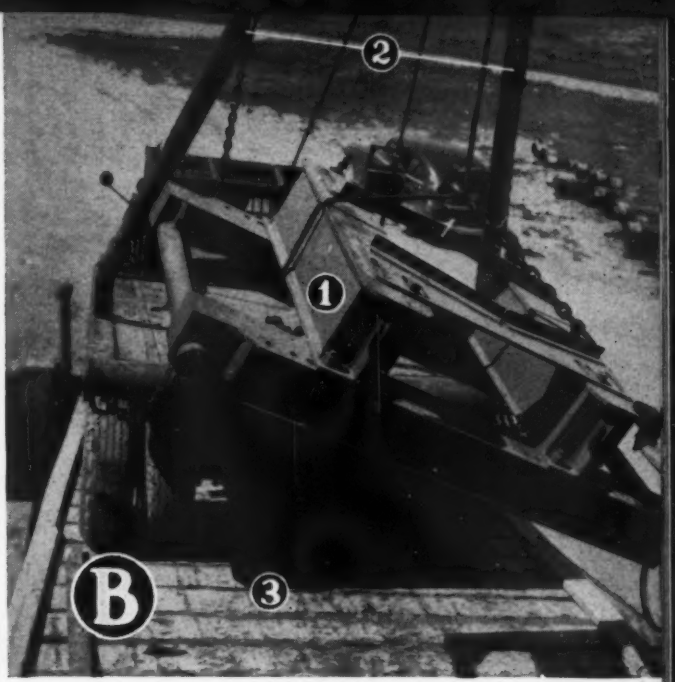




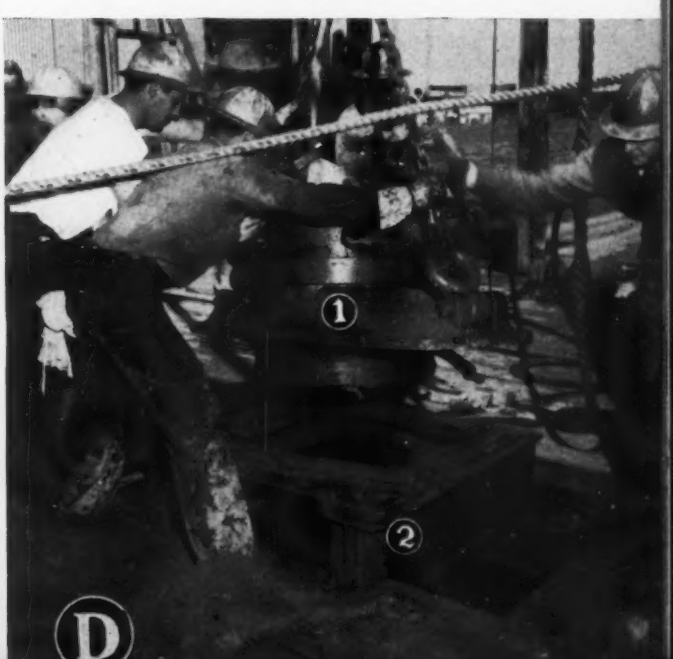
CASING OPERATIONS (Continued)

A. REMOVING ROTARY TABLE.—Utilizing a steel cable sling on the hook and around the pinion shaft of the rotary table, driller throws the clutch on the draw works to lift the rotary-table assembly weighing 9,800 lb. from the steel I-beams which support it. In its place will be lowered the casing spider support. Number (1) points to the rotary table, (2) to the table housing, (3) to the rotary-table pinion shaft and sprocket gear, and (4) to the I-beam. The sprocket gear is driven by a chain from the draw works. On the other end of the rotary-table pinion shaft is a bevel gear which drives the bevel ring gear to revolve the rotary table while drilling. Number (5) identifies the jaws of one of the rotary tongs and (6) the racked fourbles.

B. UNLOADING CASING SPIDER.—The support (1) for the automatic-grip casing spider is easily hauled up to the derrick floor by the gin-pole truck. The support (1) weighs 1¼ tons. Number (2) points to the gin poles on the truck and (3) to the 3-in. planking which floors the ramp.

C. SETTING SPIDER SUPPORT.—Rotary helper holding to the looped end of the cat line (1) guides in the casing spider support (2) while other members of the crew push it into place. The support is lowered into the opening (3) from which the rotary table has just been removed. Number (4) identifies the kelly which is out of the way in the rathole.

D. POSITIONING CASING SPIDER.—The crew stabs the automatic-grip casing spider (1) into the casing spider support (2). The automatic-grip casing spider is a heavy steel ring, its inner wall a tapered seat holding four slips (wedge-shaped pieces of steel). When it is necessary to support the casing string at derrick-floor level, a manually operated shifter lever rotates a cam allowing the slips to slide down the tapered seat and tightly grip the casing. The automatic-grip casing elevator (see next page, photo G) is similarly designed, its inner wall a tapered seat for slips which are lowered or raised by a manually operated shifter lever. These tools are used together in running casing as a positive prevention against dropping the casing in the hole. It is impossible to release the slips in one tool until the other tool has taken the load of the casing string. Hence the name "automatic grip" describes this two-tool team of casing spider and elevator.



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CASING OPERATIONS (Continued)

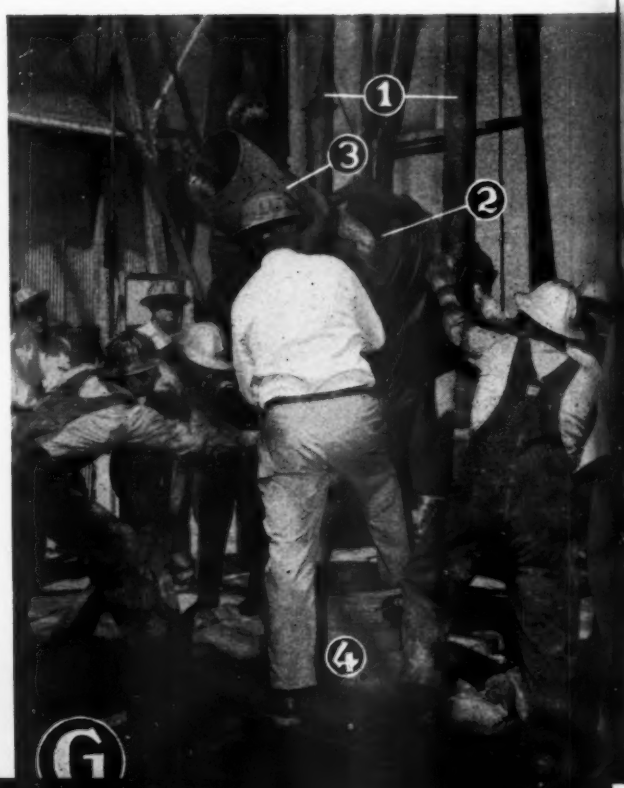
E. FLOAT COLLAR AND CASING.—Head welder welds the casing float collar on the top of the first joint of 10¾-in. The welder's mask (1) has a fractureproof dark window to protect the welder's eyes from the glare of the electric arc (2) and from any hot slag that might fly off in cooling. Number (3) labels the float collar and (4) the ground circuit to the welding machine.

F. ALL HANDS SHOVE.—In rigging up to run casing, men stab the hook (1) onto the bail (2) of the casing elevator. The hook weighs nearly a ton and has a carrying capacity of 300 tons.

G. TOP END OF FIRST JOINT.—Rotary men slide the automatic grip casing elevator over the float collar and onto the first joint of 10¾-in. casing to be run in the hole. Number (1) points to the bail of elevator, (2) one of the four slips which ride in the tapered seat of the elevator and form a tight wedge between the seat and the casing to firmly grip and support the casing string when the automatic grip elevator carries the casing load. Number (3) points to the float collar, (4) to the casing spider.

H. BOTTOM OF FIRST JOINT.—This shows the main portion of the first joint of casing just after it has been brought in from the rack and while the crew shown in photo G are attaching the automatic-grip casing elevator. Number (1) identifies the cat line, (2) the cat-line hook, (3) the rope sling, and (4) the casing. District petroleum engineer helps guide in the first joint of casing.

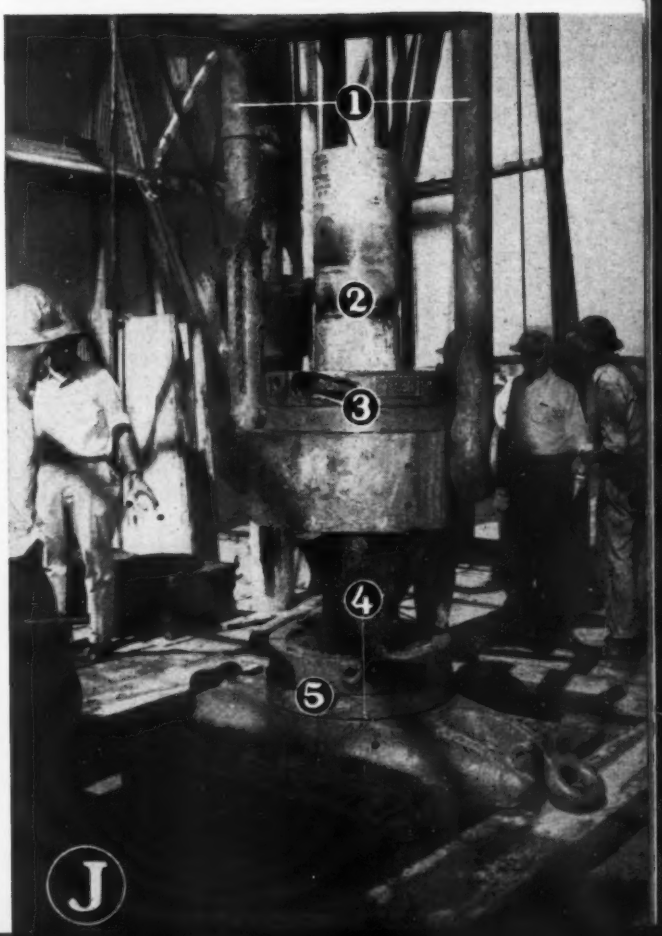
I. CASING GOES INTO HOLE.—The crew lines up the first joint of casing (1) and the casing float shoe (2) to stab them through the casing spider (3) and into the hole. The casing float shoe (2) reinforces and guides the casing as it is run in the hole. As its name implies, the shoe further "floats" the casing in the hole. The shoe contains a ball check valve, so that while cement



CASING OPERATIONS (Continued)

may be pumped down the casing and out the bottom of the shoe, no fluid in the hole can enter the casing. The valve is in effect a one-way door swinging out only. While the casing is being run the float shoe acts as a plug on the bottom end of the casing string, so that the mud in the hole displaces a considerable amount of weight of the casing thus lessening the strain on the hoisting lines and elevator or on the casing spider. The ball valve and nose of the shoe are made of drillable material. With casing landed on bottom and cemented, the nose and valve of the shoe can readily be drilled up.

J. EQUIPMENT DETAILS.—Number (1) points to the automatic-grip casing-elevator bail. Welded to the top of the first joint of casing, the float collar (2) contains a ball valve and seat identical to that in the float shoe. The float collar is an added safety factor. In the event the ball valve in the float shoe should fail, the float collar will perform the same job. Number (3) labels one of the four slots in the casing elevator. In these slots ride cams which raise and lower the slips. Number (4) points to the top of the first joint of 10¾-in. A steel bar will be slipped into the round opening at (5) and the upper portion of the spider turned to drop the slips and take load of the joint of casing, as the elevator is lowered a few inches and released from the joint. Since the hole is open until the first joint is run, the automatic-grip casing elevator is used in hoisting the first joint of casing up derrick and lowering it into the hole to be supported in the slips of the casing spider. Were the single-joint elevator which is attached to the hook by wire lines as shown in diagram used, there would be the possibility of the lines breaking and the first joint falling through the open spider to the bottom of the hole, causing a costly fishing job. The single-joint elevator shown in the diagram and described in the text is used to hoist up derrick and lower into stabbing position all succeeding joints of casing. However, the automatic-grip casing elevator is used to lower the entire casing string to the spider immediately as each joint has been made up into the string.



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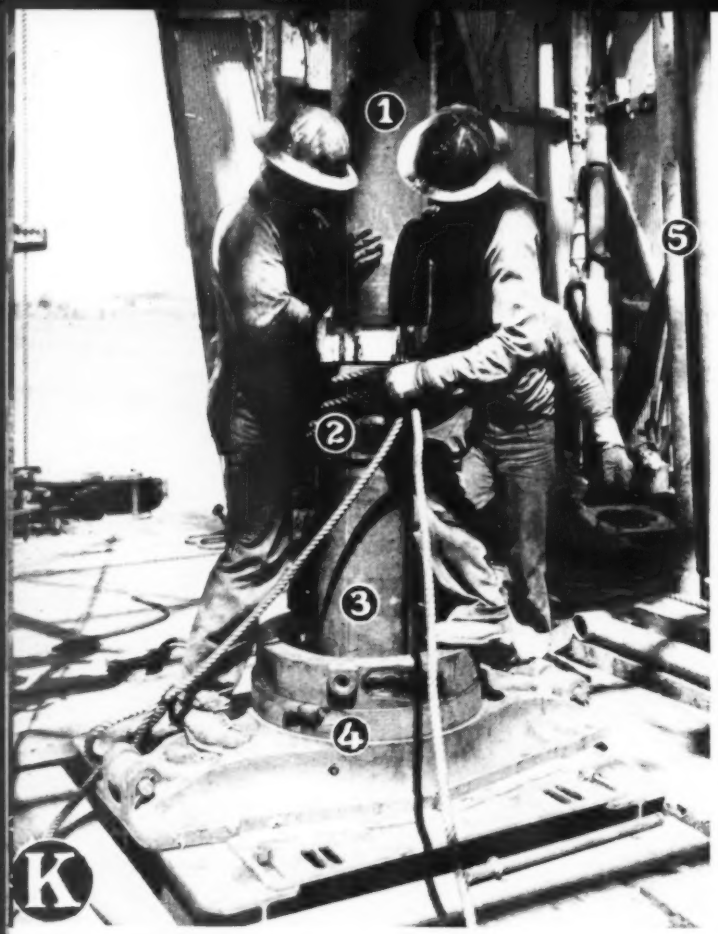

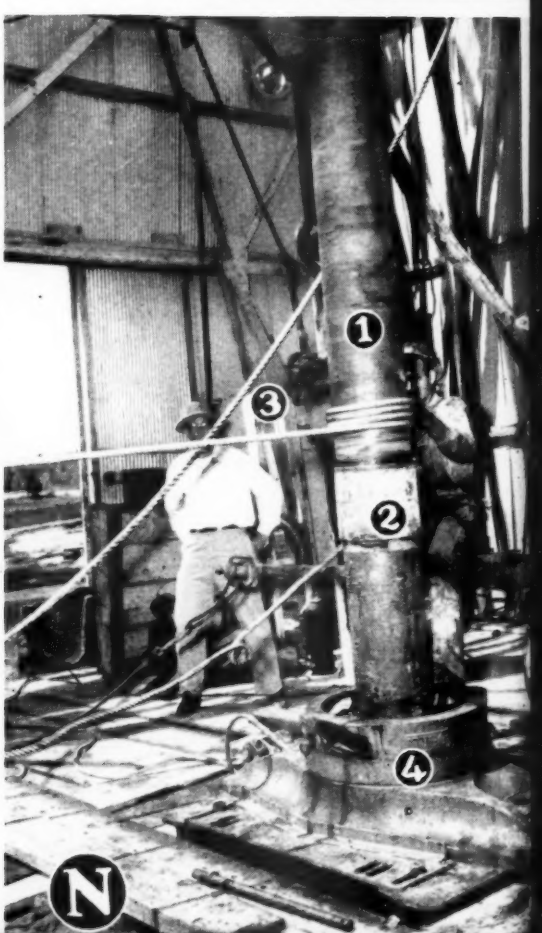

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CASING OPERATIONS (Continued)

K. STABBING ANOTHER JOINT.—Rotary helper stabs a joint of casing (1) into the collar (2) of the preceding joint (3) in the string of 10¾-in., supported by the casing spider (4). Rotary fireman has wrapped the spinning line around the collar ready to pull the free end to spin in the joint as shown in photo N.

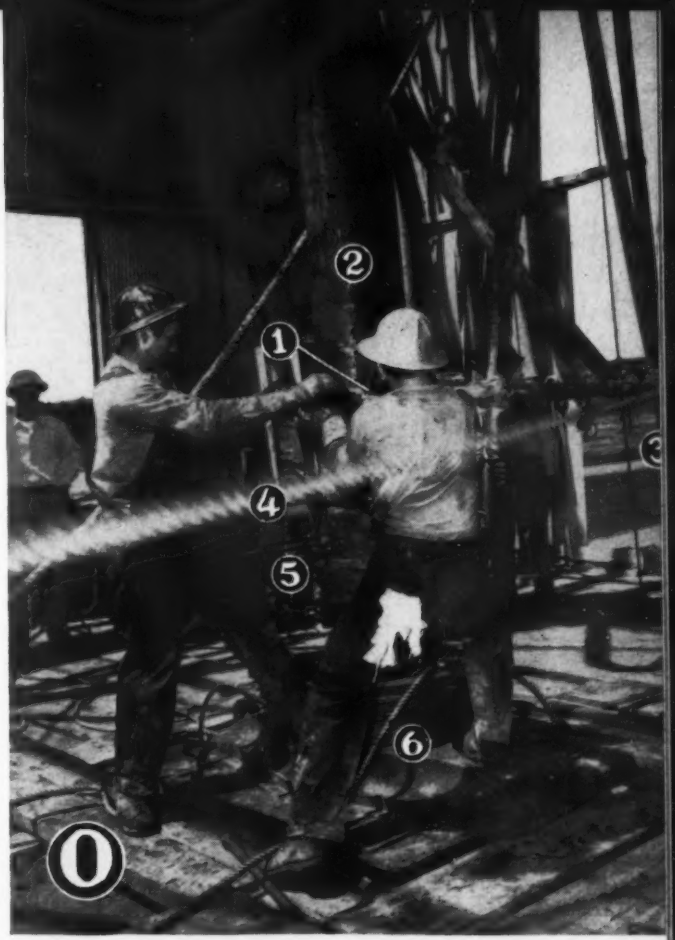
L. DERRICK ACTION WHILE STABBING.—Meanwhile, derrick men on the stabbing boards 40 ft. above, line up and stab the joint. Derrick man on the lower board has his hand on the single-joint elevator ready to unlatch it as soon as the joint is stabbed. The elevator is attached by wire lines to the hook. Number (1) identifies the block, (2) the hook, (3) the automatic grip casing elevator which is not used in this phase of the operation, (4) the stabbing boards, (5) the joint of casing, (6) the racked fourbles of drill pipe.

M. CATHEADING.—Derrick man pulls the spinning line (1) wrapped around the revolving cathead (2) which puts pulling power on the line to spin in the casing.

N. SPINNING.—The joint of casing (1) spins into the collar (2) of the top joint of casing in the hole, as rotary fireman keeps tension on the other end of the spinning line wrapped around the joint of casing being spun in. The spinning line (3) is being pulled rapidly to the left by the revolving cathead. Meanwhile, up derrick the derrick men have guided the automatic-grip casing elevator (Number 3 in photo L) over the collar of the joint in position to take hold of the top joint after it is spun and tonged up. The casing will then be lowered just above the spider, there to be supported while the next joint is added.

O. TONGING.—Rotary fireman and rotary helper steady the tongs while the joint is being tonged up by the cathead man. The jaws (1) of the rotary tong in the makeup position grip the lower end of the casing joint (2). At the end of the tong arm (3) is attached the tong line (4). Note the vibration of the tong line being stretched taut by the revolving cathead as it pulls on the tong arm to put a final turn on the casing joint for a tight connection. Number (5) labels the jaws of the other rotary tong in the backup position to hold the casing string from turning as the new joint is being tonged up. Number (6) identifies the casing spider.

P. WELDING.—Head welder and foreman spot weld the connection of the third joint of casing (1) at the top of the collar (2) of second joint of casing. Note that the bottom of collar is also spot welded. The tarpaulin (3) is thrown around the casing and over the spider as a precaution against any small tools or parts being inadvertently dropped into the hole. Connections of the first several joints of casing run are spot welded, because in drilling out the casing shoe and cement, should the cement fail to hold around the casing at the bottom of the hole, the lower joints might otherwise be unscrewed from the casing string by the drag of the revolving bit against the casing shoe.



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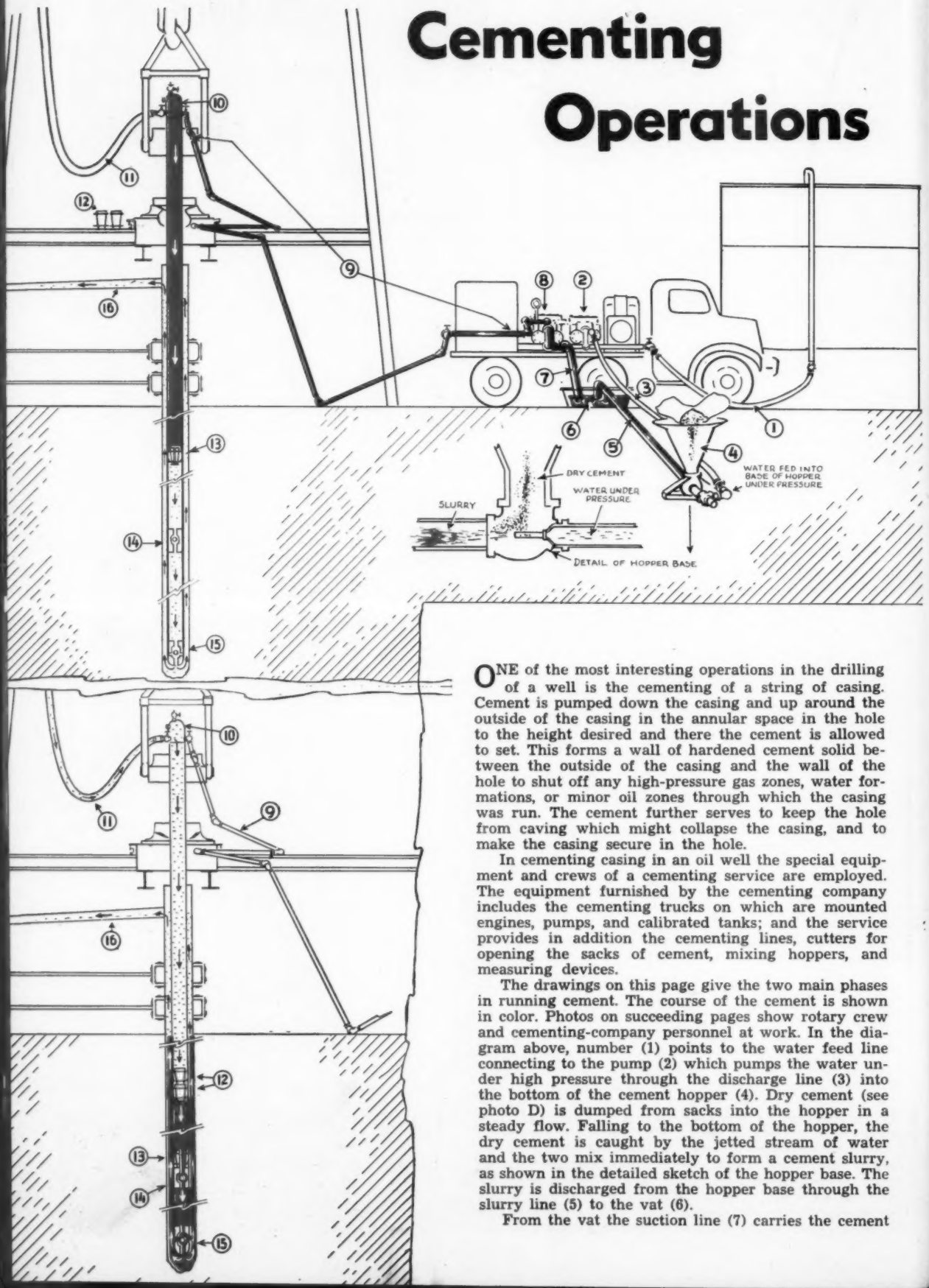
Cementing Operations

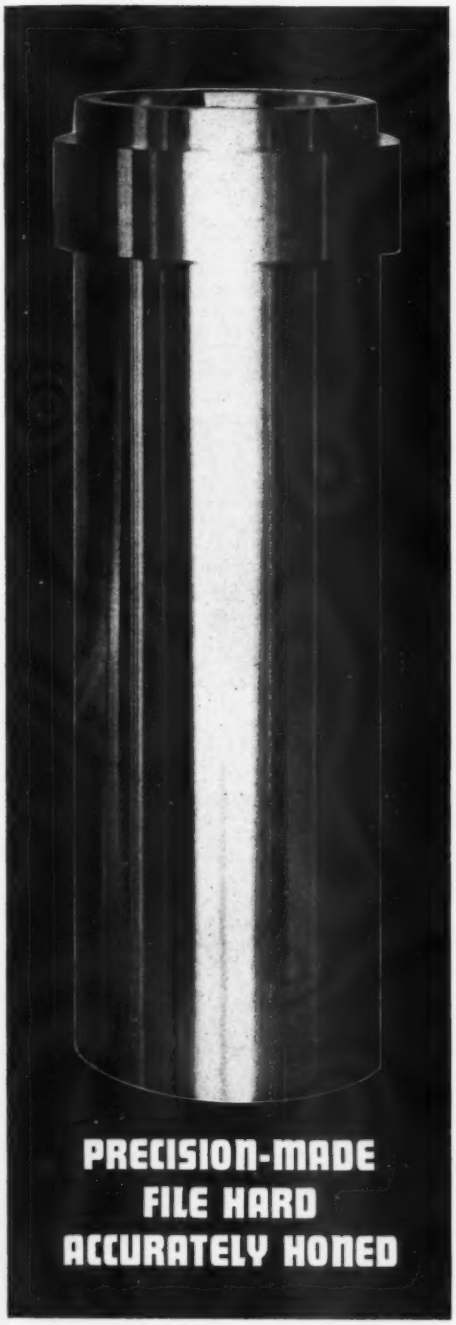


ONE of the most interesting operations in the drilling of a well is the cementing of a string of casing. Cement is pumped down the casing and up around the outside of the casing in the annular space in the hole to the height desired and there the cement is allowed to set. This forms a wall of hardened cement solid between the outside of the casing and the wall of the hole to shut off any high-pressure gas zones, water formations, or minor oil zones through which the casing was run. The cement further serves to keep the hole from caving which might collapse the casing, and to make the casing secure in the hole.

In cementing casing in an oil well the special equipment and crews of a cementing service are employed. The equipment furnished by the cementing company includes the cementing trucks on which are mounted engines, pumps, and calibrated tanks; and the service provides in addition the cementing lines, cutters for opening the sacks of cement, mixing hoppers, and measuring devices.

The drawings on this page give the two main phases in running cement. The course of the cement is shown in color. Photos on succeeding pages show rotary crew and cementing-company personnel at work. In the diagram above, number (1) points to the water feed line connecting to the pump (2) which pumps the water under high pressure through the discharge line (3) into the bottom of the cement hopper (4). Dry cement (see photo D) is dumped from sacks into the hopper in a steady flow. Falling to the bottom of the hopper, the dry cement is caught by the jetted stream of water and the two mix immediately to form a cement slurry, as shown in the detailed sketch of the hopper base. The slurry is discharged from the hopper base through the slurry line (5) to the vat (6).

From the vat the suction line (7) carries the cement



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slurry to the pump (8) which discharges the slurry under high pressure through the line (9) to the cementing head (10) into the casing.

Number (11) identifies the rotary hose, and (12) the two top cementing plugs which are used in the second phase of the operation.

Ahead of the cement slurry being pumped down the casing, as shown in the upper diagram, is the bottom cementing plug (13). This plug, made of wood or some plastic drillable material, separates the cement column from the mud column, so that the mud will not contaminate the cement. As the slurry and plug are pumped down the casing the cement displaces the mud in the casing and in the hole. The movement of the mud column is shown in the dotted area: through the channel of the float collar (14), out the ports of the float shoe (15), up the annular space between the outside of the casing and the wall of the hole, and out the mud flow line (16).

In most cases while the cement is being run, the driller works the casing string supported by the casing elevator on the hook, up and down in the hole to keep the cement from channeling and to make sure that the slurry completely fills the space around the casing as far up the hole as it is desired to run the cement.

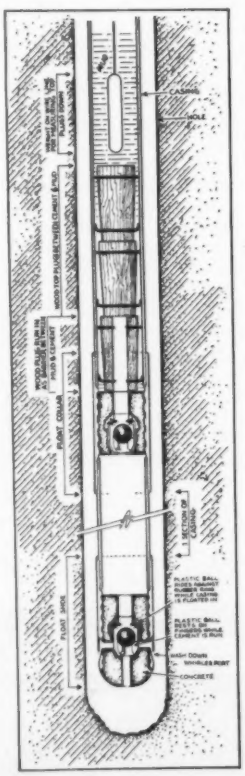
The cementing plug (13) has a hole through its center so that the slurry will flow through it when this plug bumps and seats on the float collar (14) as shown in the lower diagram.

The volume of slurry necessary to cement the casing to the desired height is predetermined. When this volume of slurry has been run, the pumps on the cementing truck are shut down, the valve on the cementing line (9) is closed. The cementing head (10) is then broken (unscrewed) from the top joint of casing and the two plugs (12) are placed in the casing on top of the column of cement. The head is made up again on the casing, the mud valve on the head opened, the rotary-rig mud pumps started, and the mud is pumped through the rotary hose (11) into the cementing head and down the casing.

The lower diagram shows the mud forcing the two plugs (12) down the casing with the cement column moving ahead through the hole in the bottom cementing plug (13), the float collar (14), out the ports of the float between the outside of the casing shoe (15), and up the annular space and the wall of the hole. The mud is indicated by the dotted area.

When a sufficient amount of mud is pumped down to fill the casing to the float collar, the two plugs (12) bump the bottom cementing plug (13). This is indicated by the pressure gages on the mud lines which show a sharp rise in pressure, since the top plugs (12) are made solid and seal the opening through the bottom plug (13) stopping the movement of the mud, and slowing down and stopping the pumps. Immediately, the mud valve on cementing head (10) is closed. The cement then will have been pumped to the proper placement from the float collar (14) filling the bottom joint, the bottom of the hole below the casing, and around the entire casing up to the desired height in the hole. The 10¾-in. string on this particular well was cemented from top to bottom on the outside for safety reasons. Enough slurry was run to cement the casing up the entire hole, so that cement returns follow the mud out of the flow line (16).

With the plugs pumped down and the valves immediately closed on the cementing head, there remains a pressure on the casing. In most cases on deep wells the pressure will run from 1,000 to 2,500 psi. This pressure is allowed to remain on the casing until the cement has set which may take up to 72 hours, depending on the conditions of the hole. On deep rotary wells the pressure on the cementing head during the setting phase of the operation must be closely watched. Accumulating heat generated by the setting cement, and from the higher temperatures deep below the earth's surface, causes the pressure in the casing to rise, and this increased pressure would damage the casing if it was not released by bleeding off (opening the valves on the cementing head) from time to time. After the plugs have bumped and the pressure is shut in, the casing should not be raised or lowered, so that the cement is undistributed and will set properly.



After the cement has been run and pumped down, the cementing lines are disconnected from the cementing head, and the cementing trucks move out for a cementing job on some other well. (While the diagram shows the hookup with only one cementing truck, actually three trucks were employed in cementing the 10¾-in. string on this well. Two of the cementing outfits were used in running the cement while a third was hooked in as a standby.

When the cement had set around the 10¾-in. casing, the cementing head was removed, the 10¾-in. was set in the slips in the landing head, and blowout-prevention equipment was installed. The rotary tools were then run, the plugs, float collar, and the cement in the bottom joint of casing and in the bottom of the hole was drilled up. The bit then on bottom started making new hole.

Summary—Cementing Operations

The principal purpose of oil-well cementing is to exclude water from the oil-producing formations. There are several other functions served by the cement, some of which are:

1. Reinforcement of casing against collapse by external pressure.
2. Protection of casing from contact with corrosive formation water.
3. Prevention of migration of fluids from one stratum to another behind the pipe.
4. Reinforcement of casing when shooting a well with nitroglycerin.
5. Prevention of gas blowouts from high-pressure zones behind casing.
6. Protection from pollution of fresh water zones behind the casing.
7. Conservation of oil and gas in shallow strata behind the casing.
8. Protection of oil string when larger strings are pulled from cable-tool wells.

Placement of cement in wells using high-pressure "squeeze" methods has been developed to the point that it may serve many special purposes, some being:

1. Reduction of gas production by squeezing cement into a gas-producing horizon exposed below the production string of casing in a well.
2. Reduction in, or exclusion of, water production closely associated with the oil.
3. Plugging leaks in casing.
4. Recementing around casing shoe.
5. Filling caverns or porous passages to prevent loss of drilling mud from a rotary well.

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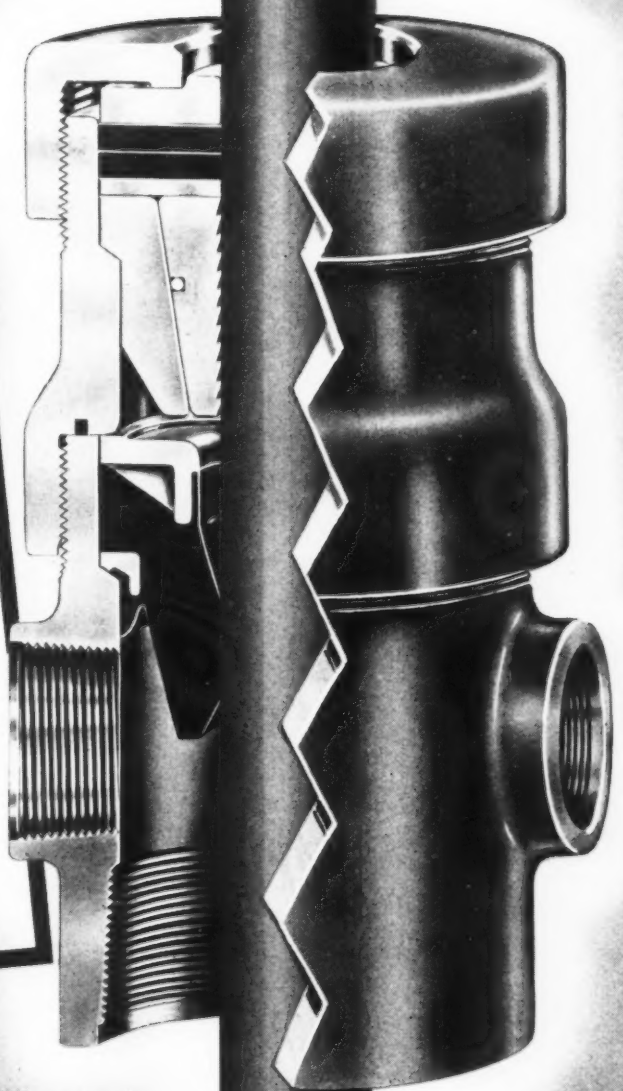

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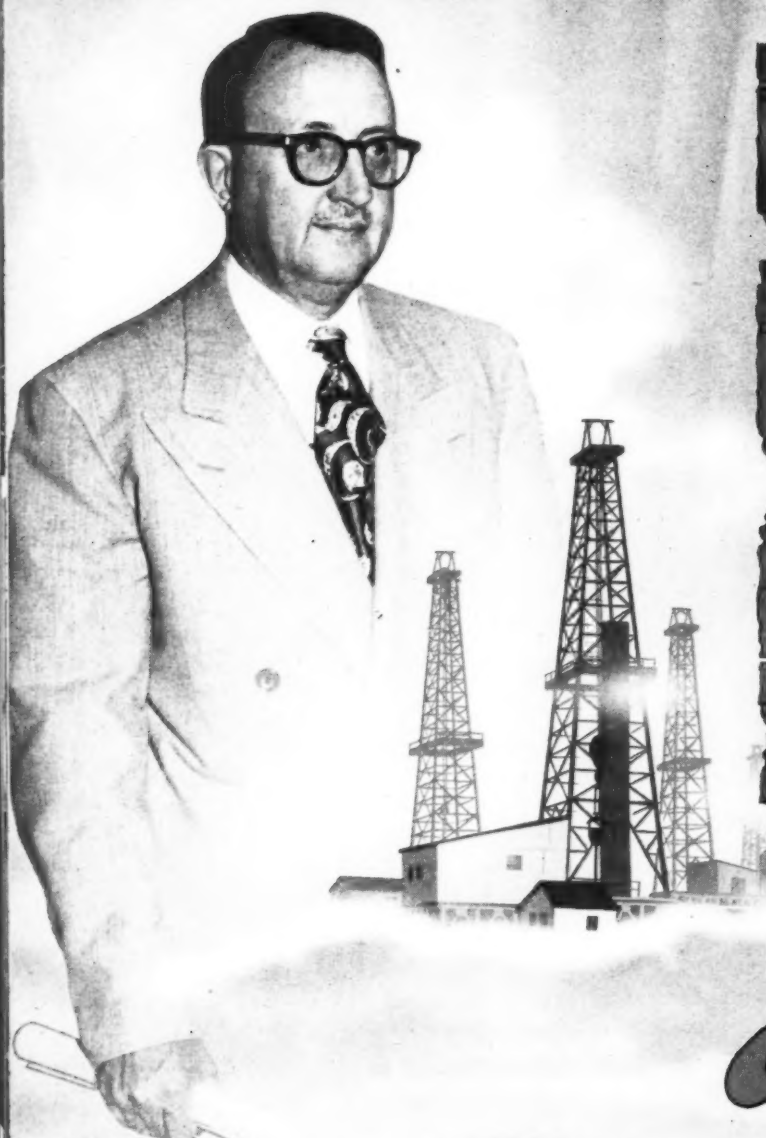

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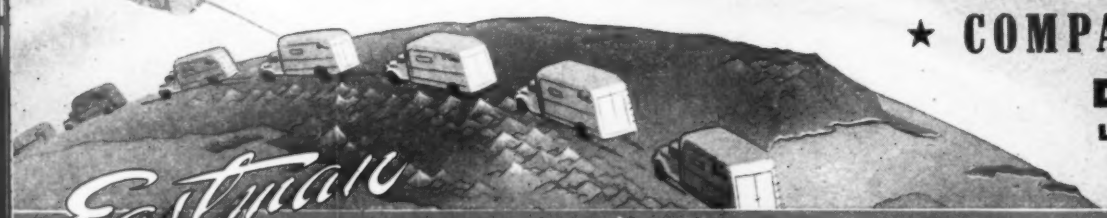

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pumps on the cementing trucks. The head shown in the photo and the hookup being made is for the purpose of circulating mud through the casing and up the annular space to make sure that there are no obstructions in the casing or around the casing before running cement. After good, free circulation has been established, the cementing head shown in photo C replaces the one shown in this photo and is used for the cementing job.

Number (1) in photo B identifies the steel hose hooked into the rotary rig pumps and the high-pressure pumps on the cementing outfits. Number (2) points to one of the swing joints in the steel hose which give the hose the necessary flexibility; so that as the mud is pumped in, the casing can be worked up and down in the hole to more readily establish free circulation.

Number (3) points to the head on the casing, (4) to the hook, (5) to the elevator bail, and (6) to the casing elevator which is supporting the 10¾-in. string. Number (7) identifies the shifter lever used to manually rotate the cam ring in the top of the elevator in setting or releasing the slips which grip the casing in the elevator. The fourbles of drill pipe (8) are racked at the side of the derrick.

CEMENTING OPERATIONS (Continued)

A. HOOKING UP, PUMP SIDE.—Personnel of the cementing company are hooking up the cementing lines of one of the three trucks employed at this well. (Two trucks were used for running the cement, and a third was a standby to provide a safety factor in case of a breakdown of any of the other cementing outfits.) The cementing crews and equipment were on hand before the entire string of casing was run, and were hooked up ready to go into action immediately after the 10¾-in. was run and circulation established.

Number (1) labels a calibrated tank which is built in two compartments. In some cases these tanks are used to measure the mud pumped down the hole to displace the cement. Mud can be pumped from the rotary rig mud tank into one of the compartments of the calibrated tank while the high-pressure pump on the cementing truck empties the other compartment in circulating mud into the hole. In this way, there is no break in the circulation of mud being pumped down the hole.

Since the rotary-rig mud pumps were used to pump down the mud to displace the cement, and the 5,174 ft. of 10¾-in. was run without tacking the casing, there was no call on the high-pressure pumps on the cementing trucks to circulate mud.

Number (2) identifies the pumps and engines assembled on the trucks, number (3) the discharge line which carries water under pressure (see diagram) to the cement hopper (4).

B. HOOKING UP, WELL SIDE.—An employe of the cementing company and derrick man tighten the union between the head on the casing and the steel hose which hooks into both the mud pumps on the rotary rig and the high-pressure

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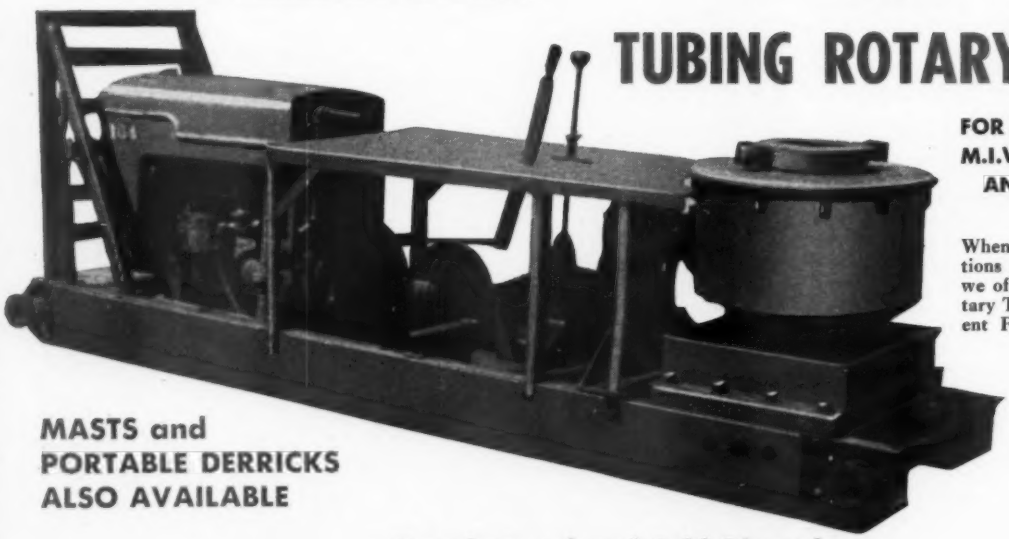

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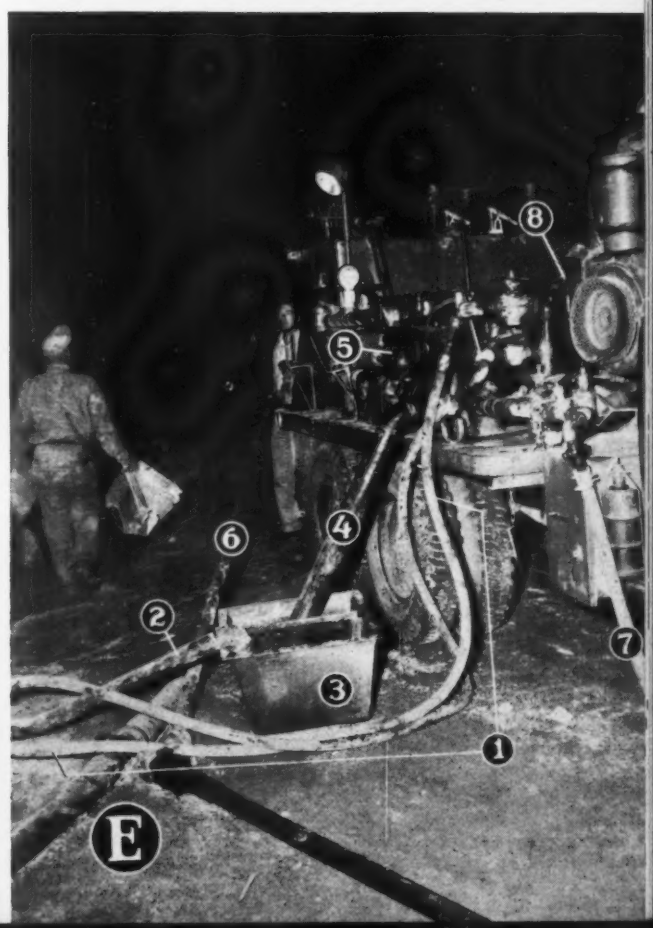
CEMENTING OPERATIONS (Continued)

C. CEMENTING HEAD.—Employes of the cementing company make up the cementing head on the casing. The hookup is shown and explained in detail by the diagrams.

D. "CUTTING" SACKS.—Oilers dump cement into the hopper. Directly behind and just the height of the hopper is a smooth steel-topped table with a sharp-tooth wheel in its center. As each of the men in the line, seen in the background, moves up and lays a 100-lb. sack of cement on the table, the oilers slide the sack across the sharp-toothed wheel, ripping open the sack, and dump the cement into the hopper. Number (1) labels the hose which brings water under high pressure into the bottom of the hopper to pick up the dry cement and mix immediately into the slurry. Number (2) points to the discharge line which carries the slurry to the vat number (3) (in photo below), while (3) in this photo identifies the pile of cement sacks.

E. EQUIPMENT DETAILS.—Number (1) brackets the line carrying water under high pressure to the cement hopper. Number (2) identifies the slurry line which discharges from the hopper into the vat (3). Number (4) labels the suction line which picks up the slurry from the vat and carries it to the pump (5) which discharges the cement slurry out the cementing line (6) connecting to the cementing head on the 10¾-in. casing. Number (7) labels the fresh water feed line to the pump (8) which discharges the fresh water through the line (1) into the base of the hopper.



XUM

NEW PORTABLE DRILLING MAST

Outstanding features are operational visibility and clear floor space, and unique method of raising and securing mast

by Roy F. Carlson
West Texas District Editor

A HIGHLY portable mast of radically different design and appearance has been rigged up in West Texas and is drilling its second well there. The new mast is unusually stable, offers a maximum in drilling-crew visibility, and affords a large amount of floor space. It can be raised rapidly and easily, and is clean and compact for moving in any one of four ways in the field. These features are accomplished by advanced principles in design and construction and by a unique method of raising the mast and securing it in the upright position.

The mast proper is in the form of a large vertical A-frame, joined at the crown and pivotally mounted at the base. A pair of auxiliary legs pivoted at ground level virtually pushes the A-frame structure into an upright position where it is securely retained by an automatic locking device.

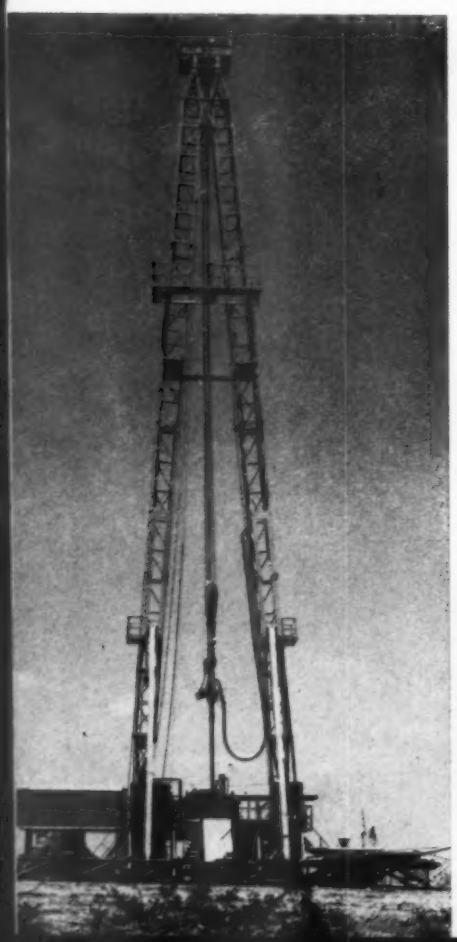
Two of the outstanding features of the mast are operational visibility and clear floor space. Excellent visibility is provided for the driller and the derrick man from floor to crown. There are no braces or girts to obstruct the driller's view of the traveling block or derrick man. The position of the legs permits the use of a wide variety of draw works and provides ample clear space around the catheads. These features make for smoother and faster operation with maximum safety.

This new mast is manufactured by International Derrick & Equipment Co. and is marketed by Ideco and its authorized distributors. The mast is being used by Lawless Drilling Co. in TXL field northwest of Odessa, Tex. A large number of the masts have been shipped to Latin America and Continental Europe.

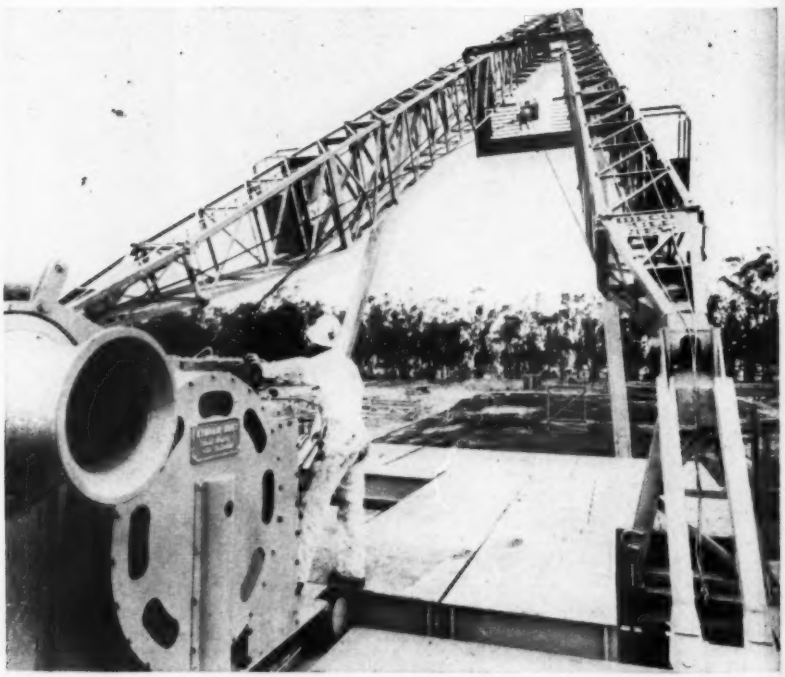
Construction

The mast uprights or legs are of latticed box construction each having a cross-sectional dimension of 3 ft. 6 in. by 7 ft. These uprights are joined at the top by the crown block and cross-brace stiffeners. At the bottom, the uprights are tapered and equipped with large pin housings for pivotal mounting on the base pedestals. The racking platform and heavy back strut provide intermediate bracing. The top 35 ft. of each upright is open on the inside to provide ample clearance for the travel of the block. A pair of auxiliary legs, which serve also as raising legs, provides a stable, self-supporting structure when the mast is upright. It is not normally guyed, but provision is made for guy lines if these become necessary.

The crown block is supported on 24-in. water-table beams which are so spaced that the entire sheave cluster may be lowered between them to the floor. Provision is made for mounting a standard gin pole at the top of the mast. All sheaves, including the catline sheave, are mounted on a single



Left: This view of the new "Full View" mast shows it on location in TXL field, West Texas. The height of the point of support of the auxiliary legs is apparent here, stiffening the mast considerably, and keeping the amount of free column to a minimum. Also obvious is the absence of anything in the mast that would impair vision up or down the tower. Below: This view shows the mast being tested just after construction, and shows it in process of being raised.



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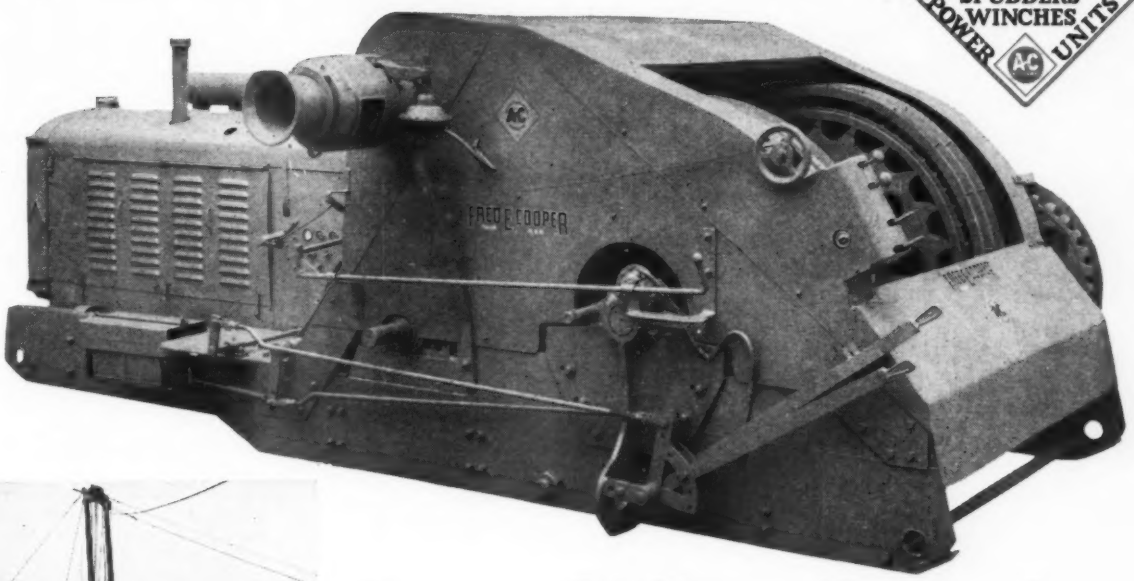

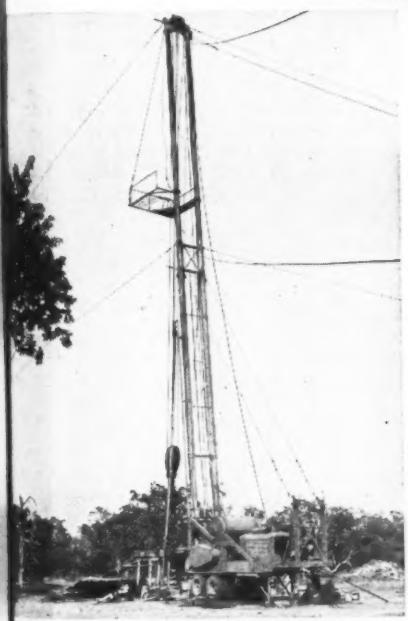

Rotary Drilling—Tailing-In Work-Over—Servicing

You'll be "money ahead" with a Cooper - Allis-Chalmers draw works and servicing equipment, not only because of lower first cost, but also you will enjoy low maintenance for ten, fifteen and many more years to come. Engineered and built to eliminate excessive weight, these rugged, compact units are exceptionally easy to move and rig-up.

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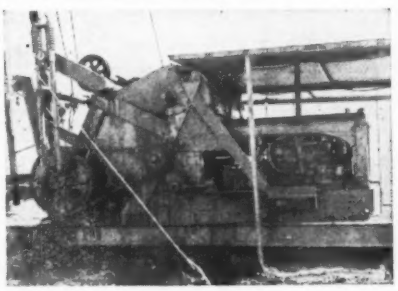

Cooper - Allis-Chalmers units are built in over 30 models—Tractor Units—Skid Units—and Trailer Rigs. There is a proper model and size for every well servicing job.

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Model W for wells to 3000′
Model E for wells to 5000′
Model M for wells to 4000′
Model L for wells to 10,000′, servicing 2½″ upset tubing.

Let us furnish you complete details. Better still, see for yourself how our units are proving to be "money makers" on the job.

TOP: Model L-844, Draw Works for Rotary Drilling to 4,500 feet*, Work-over and Servicing to 10,000 feet.
MIDDLE: Model L Trailer Rig with 85-foot heavy mast and racking board.
BOTTOM: Model E-563, for Rotary Drilling to 3,000 feet*, Tailing-in, Cleanout and Servicing to 6,000 feet.

*With 3½-inch drill pipe.

Air controlled, positive clutches—easy and fast to operate—no slipping — no heating — trouble - free — saves hundreds of pounds in weight — saves hundreds of dollars in first cost and maintenance.

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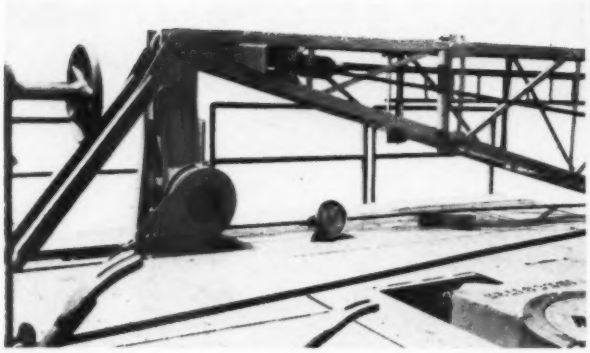
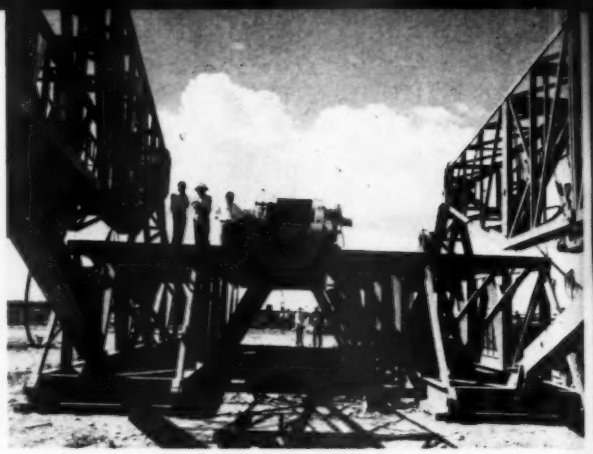


The mast leg base pedestal is shown here along with the deadline anchor, and part of the reeving of the raising mechanism. The line that is shown running along the mast leg goes to the raising yoke.



Twin boxes are joined together through sledge-pin connections and heavy beams to form substructure. The raising legs of the mast are shown pinned to base of structure in foreground.

shaft, permitting over-and-over reeving of the drilling line.

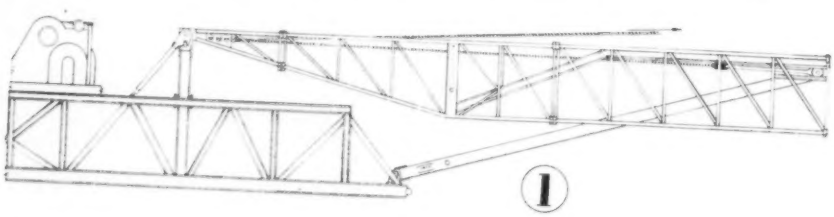
The racking platform extends around three sides of the mast and serves as an intermediate stiffener for the uprights. The fourth side of the mast is braced by a heavy back strut attached just below the platform. The platform may be positioned at any of three elevations over a 10-ft. range. Fingers are provided for racking 12,975 ft. of 4½-in. drill pipe with setbacks on either side of the mast, the pipe leaning in the direction of greatest mast stability. Platform rails are 6 ft. high to facilitate attachment of windbreak canvas.

Raising Mechanism

The substructure comprises two pairs of welded panel trusses with knocked-down framing members for field bolting into two box structures each 7 ft. 6 in. wide. The boxes are joined by knee braces and bottom ties having sledge pin connectors. The substructure is floored with steel plate consistent with the floor loading. Stairways with burred plate treads and pipe handrails provide access to the rig floor.

Upright sections of the mast are prefabricated and are fitted together with matching connectors and bolts so the structure may be assembled in a horizontal position ready for raising. The raising mechanism consists of a pair of raising legs, a block-and-tackle arrangement, and a roller-and-track system. The raising legs are made in the form of 12-in. box sections 40 ft.

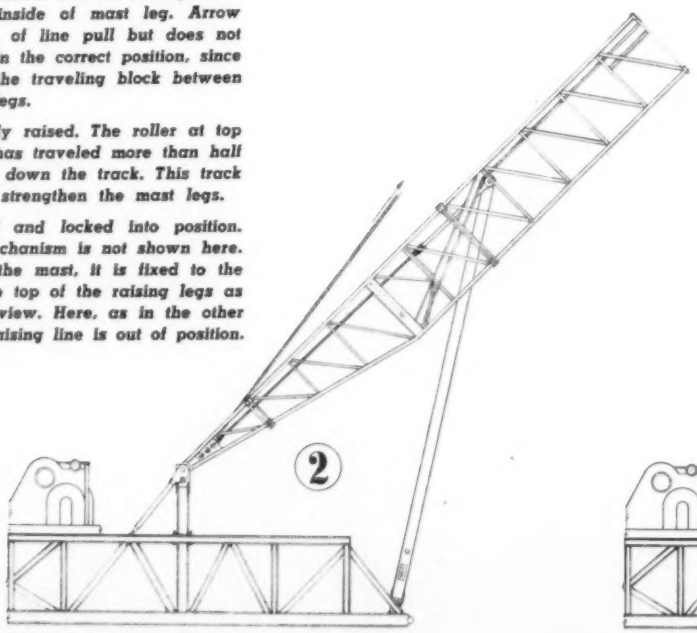
(Continued on page 250)

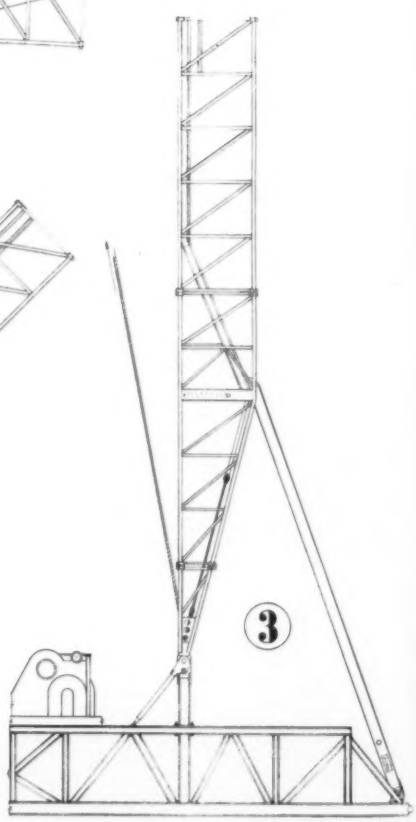


1. Mast horizontal, but with the raising mechanism reeved inside of mast leg. Arrow shows direction of line pull but does not show the line in the correct position, since it connects to the traveling block between the two mast legs.

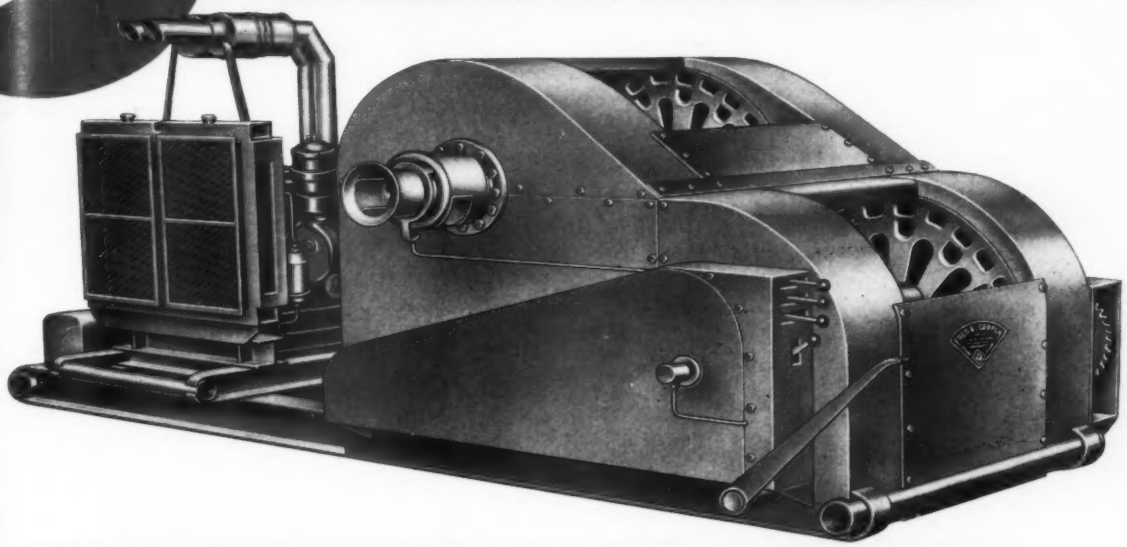
2. Mast partially raised. The roller at top of raising leg has traveled more than half of the distance down the track. This track also serves to strengthen the mast legs.

3. Mast raised and locked into position. The locking mechanism is not shown here. In position in the mast, it is fixed to the mast leg at the top of the raising legs as shown in this view. Here, as in the other sketched, the raising line is out of position.





NEW COOPER D-5000



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   No lost time in stopping to shift gears.
   Maximum speed and efficiency with any load.
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Gaskets for the Oil Industry

by H. H. Dunkle*

THE oil industry has been the most important factor responsible for the development and growth of the metallic gasket industry. This was one of the first to require the use of innumerable joints that could be easily disassembled in lines and vessels handling a wide range of pressures and temperatures. In the last few years, the pressure limits have been extended to include a range from a full vacuum to 30,000 psi., and the temperature limits range from 320° F. below zero to nearly 2,000° F.

In spite of the range of temperatures and pressures that must be held and the wide variation in the equipment to be sealed, relatively few of the available materials and styles of gaskets are in general usage in the oil industry. Any discussion of gaskets can be confined to the six basic styles shown in Fig. 1. This paper outlines the merits and limitations of each of these gaskets and points out various features of installation technique or closure design that may affect their performance.

Nonmetallic gaskets such as those cut from sheet packing and similar relatively soft materials may be readily seated or sealed in the flanged joints normally used throughout the oil industry. However, metallic gaskets, being fabricated from hard materials, are much more difficult to seal, and a brief review of the problems of gasket design will help to explain the relative merits and limitations of the different types.

In Fig. 1 is shown the force that must be applied to each square inch of gasket area in order initially to seat the different styles of gaskets. These gasket stresses are only approximate but indicate the relative ease or difficulty to be expected in initially molding the gaskets to flange contact faces that have been provided with a smooth machined surface finish. The values would be many times higher for rough facings and somewhat lower for ground and lapping facings. The use of a gasket compound also lowers the values considerably.

A perfect joint is one in which all clearance between the gasket and contact faces has been reduced to zero, and no confined fluid or gas can escape, except by diffusion through the material itself. This perfection is seldom reached in commercial practice, an adequate seal being obtained when the clearance has been reduced sufficiently to prevent leakage of the particular fluid or gas at the pressures involved through what little clearance remains. This is an important point to remember because it is the only possible explanation for the successful use of certain metallic gaskets without a coating of gasket compound in the 150-lb. series flanges.

The majority of joints in oil-industry installations are forged steel, raised-face flanges made to the A.S.A. standards for 150 lb. and 300 lb. The special features of the ring-type joint flanges used for high-temperature or high-pressure applications will be discussed further on.

The A.S.A. flanges have certain features that must be recognized if they are to be sealed successfully with metallic gaskets. There is no constant relationship from size to size between the bolt force available to seat a gasket and the area of the flange contact face. It has been the practice of the oil industry for years to demand that a gasket, whether it be sheet packing or metallic, cover the entire area of the flange contact face.

Reference to Fig. 1 shows that the different gasket styles require stresses varying from 1,000 to 6,000 psi. in order to obtain an initial seal on a smooth flange surface. It is easy to understand that if bolt stresses are held at a constant value in a given flange size, the gasket size should be different for each style of gasket.

"Phonogenic" Finish

Since the industry demands that all gaskets for a given flange size have the same dimensions regardless of material, obviously the bolt force applied must be higher for one type than for another, if the same degree of seal is to be obtained.

Furthermore, it is the exception rather than the rule of the industry to use flanges with smooth machined faces for general service. The standard surface finish appears to be the "phonographic" type or a modification of it. This facing consists of a relatively deep groove either V or U-shaped that runs in a spiral from the bore of the flange to the outer edge of the raised face. Originally developed to provide radial reinforcement for soft, nonmetallic gasket materials, it is still being furnished by many flange manufacturers as the standard facing for all purposes.

The phonograph type of facing is not difficult to seal with nonmetallic gaskets, although it is easily demonstrated that such a facing actually requires a higher initial gasket stress than a fine-tool machined finish. However, the common gasket metals cannot be compressed sufficiently to force them into a phonographic facing and fill the groove. There is always a space between the bottom of the groove and the gasket. When

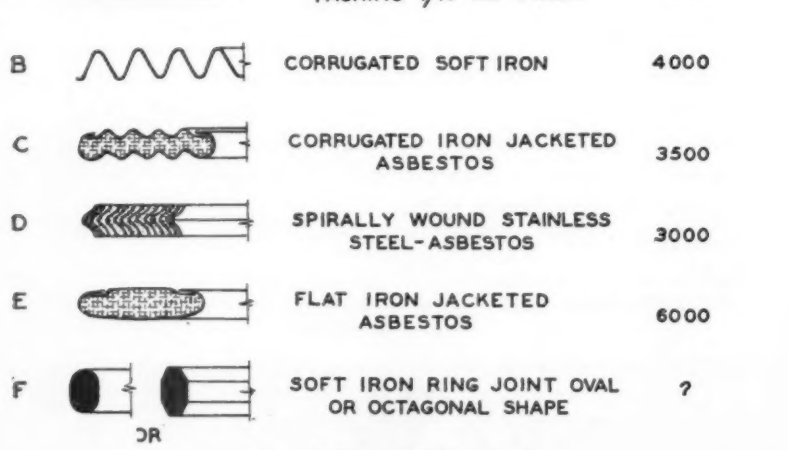

Fig. 1—Popular oil-industry gaskets.

*Johns-Manville Sales Corp., New York. Presented at A.S.M.E. Petroleum Mechanical Engineering Conference, New Orleans.

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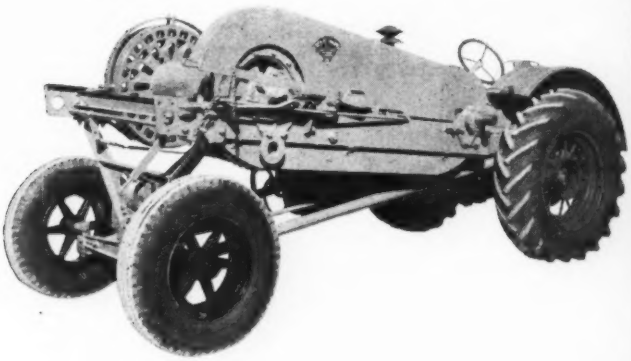

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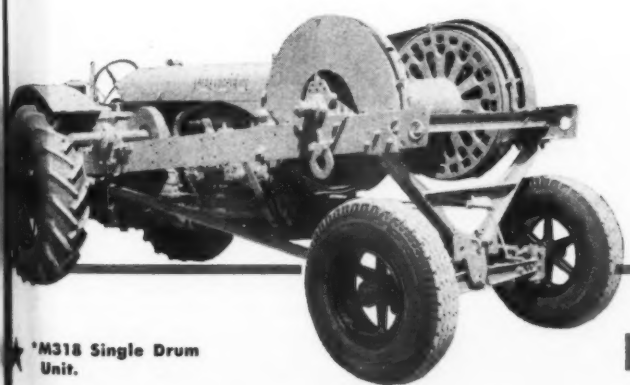
Model M for wells to 4000′
Model E for wells to 5000′
Model L for wells to 10,000′, servicing 2½″ upset tubing.

All models built in Single or Double drums. Can be equipped with telescoping mast, spudding equipment or rotary drive.



*M318 Single Drum Unit.

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metal gaskets must be used against such facings, it may be almost impossible to obtain a tight joint, unless a gasket compound is used to fill the groove. In order to hold the compound in place and prevent its being washed or blown out through the spiral channel, extremely high gasket stresses must be applied to force the gasket as far as possible into the groove.

Since the oil industry is concerned primarily with the 150 and 300-lb. series flanges, let us examine them in the light of the foregoing discussion. Assuming a bolt stress of 20,000 psi. and a gasket covering the entire area of a raised-face welding-neck flange, it will be found that many of the 150-lb. sizes do not have enough force available to seal any of the metallic gaskets. The 3 and 8-in. sizes are particularly poor in this respect. Refinery maintenance men will admit that extra-length wrenches are required to tighten most 150-lb. flanges if metal gaskets are being installed.

The 300-lb. flanges are not as troublesome as the 150-lb. because, size for size, the bolting is somewhat heavier and only when the full pressure rating is utilized must the bolts be initially overstressed.

Initial overstressing of the flange bolts to two or three times the design stress will do no particular harm. The flanges will dish somewhat under these stresses, but generally suffer no permanent damage. Furthermore, within a short time after the pipe line has gone into operation, particularly if the temperature is high, the bolts, flanges, and gasket will "relax," the total effect of which is generally an over-all reduction in stress to values close to the design limits. There are, of course, certain combinations of conditions that will prohibit the application of bolt stresses much above the design limit, but these are exceptional in general refinery operation.

Initial overstressing of bolts and flanges can be avoided by modifying gasket dimensions. This is most easily done by increasing the inside diameter of the gasket to the point where the gasket area is such that it can be sealed with lower bolt stresses. This reduction in the width of some metallic gaskets dimensioned for standard flanges has become imperative for another reason.

Today more and more refineries and gasoline plants are using slip-on flanges where previously welding-neck or lapped-joint were installed. The flexibility of design and smaller fitting inventories, plus ease of fabrication, have increased the use of slip-on flanges to the point where they now greatly outnumber the other types for general piping work.

The gasket contact face of a slip-on flange is narrower than the face of a welding-neck flange, the difference amounting to twice the wall thickness of the pipe. In the smaller sizes of the 150 and 300-lb. flanges, this difference in contact face width results in a high percentage reduction in gasket area, enough so that in many instances the need for overstressing of the bolts may be almost entirely eliminated.

However, the use of these slip-on flanges presents a problem to the users of gaskets such as are shown in Fig. 1 as c, d, and e. With these gaskets, the primary seal is provided by the compression of the inner lapped-over edges of styles c and e, or the inner metal-to-metal plies of style d. If this inner edge is not firmly compressed, these gaskets will leak.

With the exception of the spirally wound type (style d), all the gaskets, including the sheet packing type, are listed in the catalogs of most gasket manufacturers in dimensions suitable only for welding-neck flanges. For example, the listed standard size for a 5-in. 150-lb. sheet-packing gasket is 3 by 5⅜ in. and the standard size for styles b, c, and e is generally shown as 3¼ by 5¼ in. with some minor differences between manufacturers and styles. The bore of a 3-in. 150-lb. welding-neck flange is 3 1/16 in., whereas the bore of a 3-in. 150-lb. slip-on flange is 3 9/16 in.

Gaskets of styles c and e dimensioned with a 3¼-in. inside diameter will not be compressed around the inner edge and will leak when used between flanges one of which is of the slip-on type. Gaskets of the styles a and b may not leak, but the unsupported portion of the gasket will project into the line causing turbulence with subsequent acceleration in the rate of corrosion or erosion, accompanied by the possibility that part of the gasket may break away and clog a valve or damage the equipment.

Plants using metal-jacketed asbestos gaskets in slip-on flanges should be certain that they have large-inside-diameter gaskets available for installation in such flanges. If the majority of lines have slip-on, only the large-inside-diameter gaskets should be carried in inventory to avoid confusion. The large i.d. gasket will seal more easily and can, of course, be used in welding-neck flanges.

The spirally wound gasket (style d) has always been dimensioned for use in slip-on flanges and only when ordered for special flanges must precautions be taken to select the proper dimensions.

Compressed Asbestos Sheet-Packing Gaskets

The gasket shown as Fig. 1a represents the material used almost universally throughout the oil industry from the time the oil comes from the well until the finished product is shipped to the consumer. Known to the trade as compressed asbestos sheet or "sheet packing," this material is essentially asbestos-fiber bonded with a small percentage of rubber compound. Because the material is relatively soft, the standard 1/16-in.-thick gasket can be sealed without excessive overstressing bolts or flanges, even though the flange facings may be in poor condition.

Sheet-packing gaskets can be used throughout a wide range of temperature and pressure conditions, and the general-purpose sheet will resist reasonably well the deteriorating attack by most oils and oil products, even though not specially compounded for resistance to these materials.

The limitations of sheet-packing gaskets are dependent upon the relationship of the operating temperature to the pressure. Sheet packing can be used to seal almost unlimited pressures at room temperature, if the closure is designed to give sufficient reinforcement and the gasket is thin. However, asbestos fiber loses its strength and turns to powder at temperatures much over 700° F., at a rate that depends upon the temperature. At 1,300° F. the change is almost instantaneous. When combined with rubber as a binder, the loss of strength is not appreciable at temperatures below about 900° F., and sheet-packing gaskets may be used without trouble for low pressures at temperatures up to 850° F. Over 850° F., it must be remembered that the sheet packing will have little strength or ability to seal in flanges subject to bending or vibration, and pressures much above 50 psi. may cause leakage.

The following rule-of-thumb may be applied as a guide in determining whether a sheet-packing gasket or a metallic gasket should be used in a given installation: "If the product found by multiplying operating pressure (psi.) by operating temperature (° F.) does not exceed 250,000, sheet-packing gaskets may be used. The rule should not be applied when pressures exceed 1,200 psi. or temperatures are over 850° F. Sheet-packing gaskets may be used at higher pressures, and perhaps, at higher temperatures, but complete data on the installation should be carefully considered before making the selection."

The limits defined by this rule-of-thumb will be found to be those in use in most refineries for gaskets in lines handling water, steam, hot oil, gas, and oil products. The packing used is the standard general-purpose material in the $\frac{1}{16}$-in. thickness. The flanges are standard A.S.A. 150 lb. and 300 lb. raised face, with either smooth machined or phonographic facings. The same material is also used in the majority of heat exchangers and process-vessel flanges. In such equipment, however, the limits may be somewhat lower, if the gasket width is less than ½ in.

Corrugated Metal Gaskets

The corrugated metal gasket shown as style b in Fig. 1 was at one time the most popular style for refinery use where sheet packing was not

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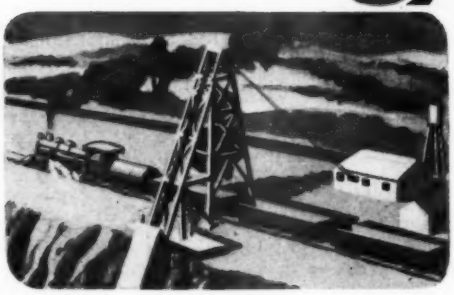

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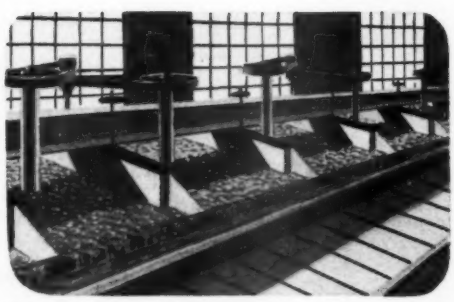

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satisfactory. The standard gasket is fabricated from 0.019-in. thick soft iron sheet and corrugated with a ¼-in. pitch. The corrugations are concentric.

When compressed between flanges, the corrugated gasket is flattened and becomes in effect a wrinkled flat washer with no resilience or ability to compensate for flange movement. Because the gasket will compress close to the original metal thickness, the flange faces must be brought up parallel. Users of this corrugated gasket have reported cases of flange and bolt breakage during installation occasioned by attempts to overcome cocked and misaligned flanges.

Unless coated with a gasket compound before installation, it is almost impossible to seat the plain corrugated gasket in 150-lb. flanges without stressing the bolts several times over the design stress. In refinery service, this gasket is seldom used without a coating of gasket compound and today generally is not used for pressures much above 50 psi.

This single-thickness corrugated-metal gasket has two fields of application in which it has proved to be particularly satisfactory. When coated with a suitable gasket compound, it is widely used to seal high-temperature low-pressure (under 100 psi.) gases in lightly bolted flanges. Also, for Dowtherm service it is standard practice to use the corrugated soft-iron gasket coated with compound in 300-lb. raised-face flanges. In these instances, it is the gasket compound that provides the seal, and the gasket itself acts as a reinforcement for the compound.

Corrugated Metal-Jacketed Asbestos Gaskets

The gasket construction, style c Fig. 1, is today the most generally used alternate for sheet-packing gaskets in refinery pipe flanges and pressure vessels. With few exceptions, the standard gasket is made up with a 0.019-in. thick soft-iron shell and washer and a filler of high-purity asbestos. The over-all gasket thickness is usually ⅛ or 5/32 in., depending upon the thickness of the filler.

This construction has many advantages over the corrugated metal (style b) and the flat metal-jacketed asbestos (style e) types. The corrugated construction allows the use of a wide gasket, but lowers the sealing stress by virtue of the reduced contact area. If fabricated with deep narrow-pitch corrugations and assembled as shown in Fig. 1 with the corrugations nesting, the gasket will not flatten out when compressed and will have sufficient resilience to maintain a seal in joints subject to considerable movement. The concentric corrugations act as labyrinth seals, should slight leakage take place across the inner edge, whereas the flat metal-jacketed asbestos gasket (style e) offers no barrier to leakage, except at the inner and outer edges.

Because of its initial thickness and its relatively soft construction, the corrugated metal-jacketed asbestos gasket can compensate for some out-or-parallelism and misalignment of flanges.

When used in 150 lb. and 300-lb. flanges, the corrugated metal-jacketed asbestos gasket will seal at lower bolt stresses than the plain corrugated metal or flat metal-jacketed asbestos gaskets. If the flanges are rough or have a phonographic finish, the gasket should be given a light coating of a gasket compound when installed.

Where failures of this type of gasket have been experienced, they can generally be traced to the use of dimensions that were not correct for the flanges involved.

Spirally Wound Metal-Asbestos Gaskets

The spirally wound gasket shown as style d in Fig. 1 consists of a preformed metal strip wound together with a strip of asbestos in the form of a spiral. At the inner and outer edges, the asbestos is eliminated, and the metal plies are welded to each other to lock the gasket.

As yet, the spirally wound gasket has not been accepted as the general-purpose refinery gasket, except in a few locations. Its use has been confined to steam and water lines, probably because of unfavorable experience some years ago with its use against oil and oil products.

Those refineries using the spirally wound gasket for all purposes have found that there are some precautions that must be taken. The standard gasket as fabricated is approximately $\frac{5}{32}$-in. thick. When installed between flanges with smooth machined faces and compressed more or less uniformly to a thickness of approximately ⅛ in., the gasket will seal against almost any liquid at high pressures and temperatures up to 900° F. Construction of the gasket is such that it has the highest resilience of any metal-asbestos gasket, actually being able to compensate for flange separations of as much as 0.005 in. without leaking. Between phonographic flange facings, however, it has been found to be necessary to compress this gasket to thickness less than ⅛ in., and a style of centering guide must be used that does not interfere with this extra compression. Installation technique must be controlled to assure uniformity of compression, otherwise the phonographic facing will not be sealed off at the inner edge of the gasket.

For service at pressures above 500 psi. or at temperatures above 500° F., it is generally accepted practice to make the spirally wound gasket with stainless steel. Below these limits, soft steel is normally used if suitably resistant to the confined fluid.

Flat Metal-Jacketed Asbestos Gaskets

The flat metal-jacketed asbestos gasket, style e Fig. 1, consists of a metal shell and washer formed to completely enclose a filler of high-purity asbestos. Although a few refineries use these gaskets in pipe flanges as an alternate for sheet packing, this construction is more generally used to seal heat exchanges and other pressure vessels in which the gasket face is relatively narrow. For flange widths over ½ in., the corrugated metal-jacketed asbestos jacket is preferred, but it is not practical to make the corrugated construction for narrower widths.

It was mentioned before that the flat metal-jacketed asbestos gasket seals only on the inner and outer edges where the metal shell laps over the filler and washer. It is therefore very important that these areas be carefully formed, when made, and firmly compressed when installed.

Several manufacturers of heat exchangers machine a raised "nubbin" ⅛-in. wide and 1/64-in. high in the contact face of one of the mating flanges. This nubbin may be used on a flat face or on the tongue of a tongue-and-groove joint. The purpose of the nubbin is to apply a localized high stress at the midline of the gasket face. When used with plain flat gaskets cut from service sheet or solid metal, the raised nubbin is a foolproof means of increasing gasket stresses. When used with metal-jacketed gaskets, however, leakage may occur because of the nubbin unless the gasket is properly installed.

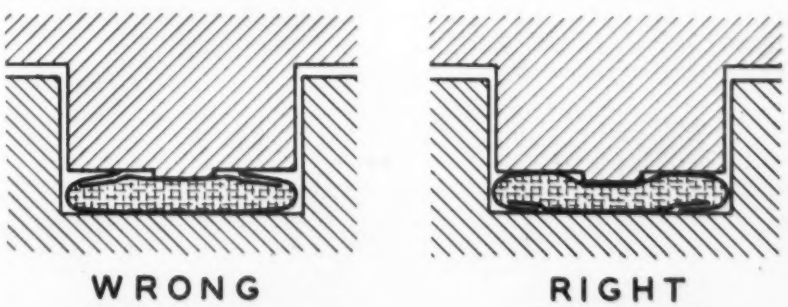

Fig. 2—Proper position to install metal-jacketed asbestos gasket in joint with raised nubbin on one face.

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Fig. 2 shows the correct position of installation of a metal-jacketed asbestos gasket in a joint, one face of which has been provided with a nubbin. The gasket must always be installed with the lapped edge side away from the nubbin or the tongue. If the lapped edges are placed against the nubbin face, the compressive load will be concentrated on the washer surface, and very little will be on the lapped edges. Leakage can and does take place under these conditions.

In making a metal-jacketed asbestos gasket with rib work, extreme care must be taken in drawing the metal at the intersections of rib and outer ring, or rib and rib, so that it will form a smooth lap of uniform width over the filler and washer. If the metal is overstressed in drawing, the metal lap will split open, allowing a leak at that point. Drawing the metal too far will cause the formation of wrinkles or folds in the lap itself. If the metal lap at any place on the gasket is folded over on itself, the gasket is thicker at this point and cannot be compressed in the surrounding areas. A cracked lap will allow slight leakage, but a fold will cause dangerous leakage.

Instances have been reported of severe erosion of channel-head baffles and serious losses in exchanger efficiency due to use of ribbed gaskets that were poorly made and on which the metal laps were folded on themselves at the intersections of the ribs with the outer rings. Gaskets of this poor quality should be avoided, particularly if the equipment is handling slurries of an abrasive nature.

In certain cases, refineries have found it to be necessary to use equipment orginially designed for sheet-packing gaskets in service requiring metal gaskets. Unless the equipment was overdesigned when built, difficulties can be expected in attempting to seal the metal gasket. Resurfacing of the gasket contact faces to provide a smooth finish and drilling out the flanges to take the next larger size of bolt may solve the problem. In some cases the gasket width can be reduced, but this generally poses a problem in location of the gasket during installation. The gasket can be held in place quite readily with strips of cellophane adhesive tape. These strips do not prevent a tight seal.

Ring-Type Joint Gaskets

Ring-type joint gaskets (Fig. 1-f) of either oval or octagonal cross-section are used in all phases of the oil industry for high-pressure and high-temperature service. They can be used only in specially grooved flanges.

The oval shape is more popular, probably due to the difference in cost, but for critical high-pressure service, particularly against steam and gas, the octagonal shape has proved to be more satisfactory.

Oval rings made from soft iron are by far the most widely used form of ring-joint gaskets. They are used in most high-pressure well-head equipment, in pipe-line-station manifolds, and in much refinery piping. Some gaskets made from a modified Type 502 alloy (4-6 per cent chrome ½ per cent Mo) are used for the more sour oils, and a few refineries are changing over to the various stainless alloys for severe corrosive service.

Most specifications call for the soft-iron gaskets to have a hardness not exceeding 90 Brinell. The A.P.I., however, specifies (A.P.I. Standard No. 6B) only that the gasket be softer than the flanges. This latter specification is not difficult to meet with soft iron or Type 502 alloy (modified) but may be impossible to comply with in the various stainless alloys.

To obtain maximum corrosion resistance in a stainless-steel flange, it is generally necessary to heat treat the material to the dead soft condition and, therefore, the flange will have the same hardness as the stainless-steel gasket.

The soft-iron oval gasket with a hardness of 90 Brinell should be easily seated in a steel flange with a hardness of not less than 140 Brinell. Nevertheless, we find that in many instances, in refinery flanges particularly, a joint using the oval ring must be very heavily bolted to prevent leakage; in fact, so heavily bolted that the flanges have dished to such an extent that only the outer edge of the gasket is providing the seal. And yet, theoretically, the oval shape should seal at very low unit stresses. The surface finish of the flange groove appears to be responsible for failures to obtain a seal with the oval ring at normal bolt stresses and is known to account for the failure of gaskets even of the octagonal shape to seal easily against high pressures. The tool marks on the surface of the tapered sides of the flange groove are exactly the same as a phonograph facing, but much finer.

When the oval gasket is installed, there is at first only a thin line of contact with the groove face. This thin line is not wide enough, nor has the gasket been wedged in the groove sufficiently to seal off these spiral tool marks which can only be accomplished by smearing of the surface of the gasket or of the groove. In order to widen the line of contact and distort enough of the gasket to seal off these marks, the bolts must be heavily stressed. This high stress, in addition to dishing the flanges and taking the load off the inner edge of the gasket, may harden the surface of the gasket, causing it to dig into the groove surface. In such cases, the groove must be remachined before the joint can be reused.

Although the octagonal ring has a wider contact face when first installed, only a light bolt load causes wedging action over a wide area of tool marks, effectively sealing the joint. Because it is not necessary to stress the bolts so heavily, the flanges are not distorted or the grooves damaged, and the gasket maintains a seal on both edges. For high-pressure steam, gases, Dowtherm, and the 10,000-psi. oil-field flanges, the ring grooves are generally given a mirror finish and octagonal rings are used.

Conclusions

In conclusion, it is worth noting that a gasketed joint is only as perfect as the mechanics in charge of the assembly. Carefully machined flanges and flawless gaskets will only perform to the satisfaction of everyone if they are handled with intelligence and recognition of a few simple rules:

1. Protect the flange faces until final assembly.
2. If not protected, clean flange faces of weld spatter, rust, old gasket, etc.
3. Protect the gasket from damage until installed.
4. Center the gasket carefully.
5. Apply bolt stresses uniformly, in small increments, and in the proper sequence.
6. Do not attempt to reuse a gasket, the saving is not worth the probability of unnecessary down time.

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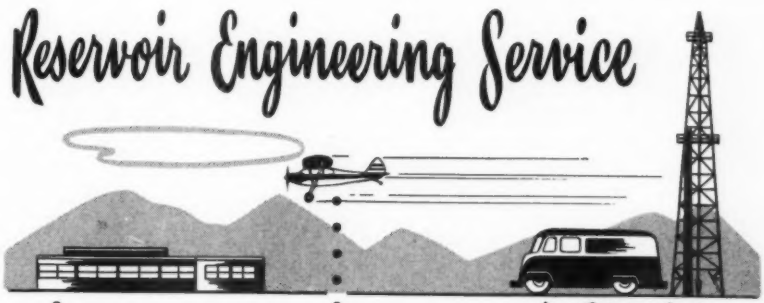

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PROCESS MONITORING SYSTEMS

by E. J. Grace*

THE increase in size of process units together with the ever-mounting dependence on instrumentation to correlate all functions of these huge installations have posed many problems for the instrument engineer in recent years. One of the most exasperating of these has been the matter of measuring at a central point the miscellaneous temperatures, pressures, levels, and flows that are not critical in the operation but are of great importance to the operator or engineer in determining the optimum operating condition of various pieces of equipment such as heat exchangers, pumps, and compressors.

In the past it has been the general practice to convert the various physical measurements involved to electrical units and run wires to a central point where a multitude of key switches was made available for the operator to select any particular point for measurement.

With an increasing number of points to measure, the space requirements for indicators and key switches became prohibitive. For an installation of 1,000 points, there is no practical method of arranging indicators and key switches that will permit an ambidextrous operator to press the switch handle and still be in a position to see the indicator. Duplication of indicators was necessary.

The problem of wiring and conduit arrangement was even more difficult—to say nothing of spares and future additions. Faced with a requirement for between 500 and 1,000 indicated temperature points and a limited panel space, an investigation into the use of circuits and equipment similar to that used in telephone work was instigated.

*Sun Oil Co. Presented at annual meeting of the Instrument Society of America, Buffalo.

Most of the systems discussed in this paper are in operation at the Toledo refinery of Sun Oil Co.

Both automatic and manual monitoring systems are described. These permit selection at a central control point of any one of a large number of devices for measuring or controlling process variables or related equipment.

The systems include means for indicating at the central point the identity of the particular unit connected to the measuring or controlling device using a feed back signal from the remotely located unit.

The following systems are described:

1. A dialing system for 1,000 points using a feed-back indicator.

2. A scanning system for 1,000 points using an indicator with alarm.

3. A continuous indicating system using one measuring device for 20 indicated points.

4. A survey system that permits recording any combination of 10 to 100 points using a dial for selection.

5. A control-point setting system that will permit remote setting of 1,000 controllers with one master unit.

6. Remote operation of electric motors, valves, etc., using a single push-button station or controller.

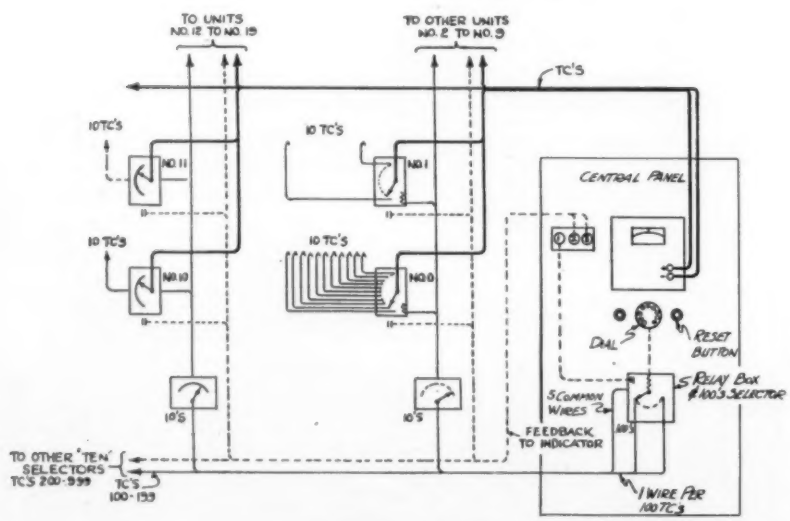

Fig. 1—Dialing system.

An analysis of many process units indicated that the best system would be one where a switching unit that would accommodate 10 points could be installed near the points of measurement with short leads from the unit to the measuring devices and then a common two-wire bus picking up all the switching units and returning to the indicating instrument.

The first complete system was designed and built by Sun Oil Co. and accommodated 400 indicating temperature points. All subsequent systems have been built by Panellit Co.

Three Separate Circuits

Each of the various systems described here contain three separate circuits: (1) the selecting circuit which operates at 45 volts d.c., (2) the measuring or controlling circuit, and (3) the checking circuit.

The stepping switches have been identified by their position in the digital system and are referred to as hundreds, tens, and unit switches. The measuring device is connected only to the unit switches.

Dial system.—This type of circuit is relatively simple and is shown diagrammatically in Fig. 1 for a maximum of 1,000 circuits. This requires the operator to dial three figures, the first two operations of the dial select a particular circuit through the switches, and the final dial operation connects a measuring device to the common bus. Note that the measuring circuit is only through the last stepping switch and does not pass through the other two switches in the system.

One feature of this system permits arrangement of the thermocouples on the stepping switches in such a manner that the operator may dial the lowest point on any unit switch, such as 321, and then run through the next nine points by adding one impulse each time.

To clear the system for the next reading, the operator must push a release button that resets all switches that have operated, to their normal open or "homed" position.

Unlike a telephone system, wrong numbers or improper dialing must be brought to the attention of the operator. Two systems have been developed to meet this requirement:

1. The use of a resistance network with three indicating voltmeters to show the position of each digital unit—hundreds, tens, and units.

2. An electrical impulse fed back from a stepping switch to an identical stepping unit to which has been at-

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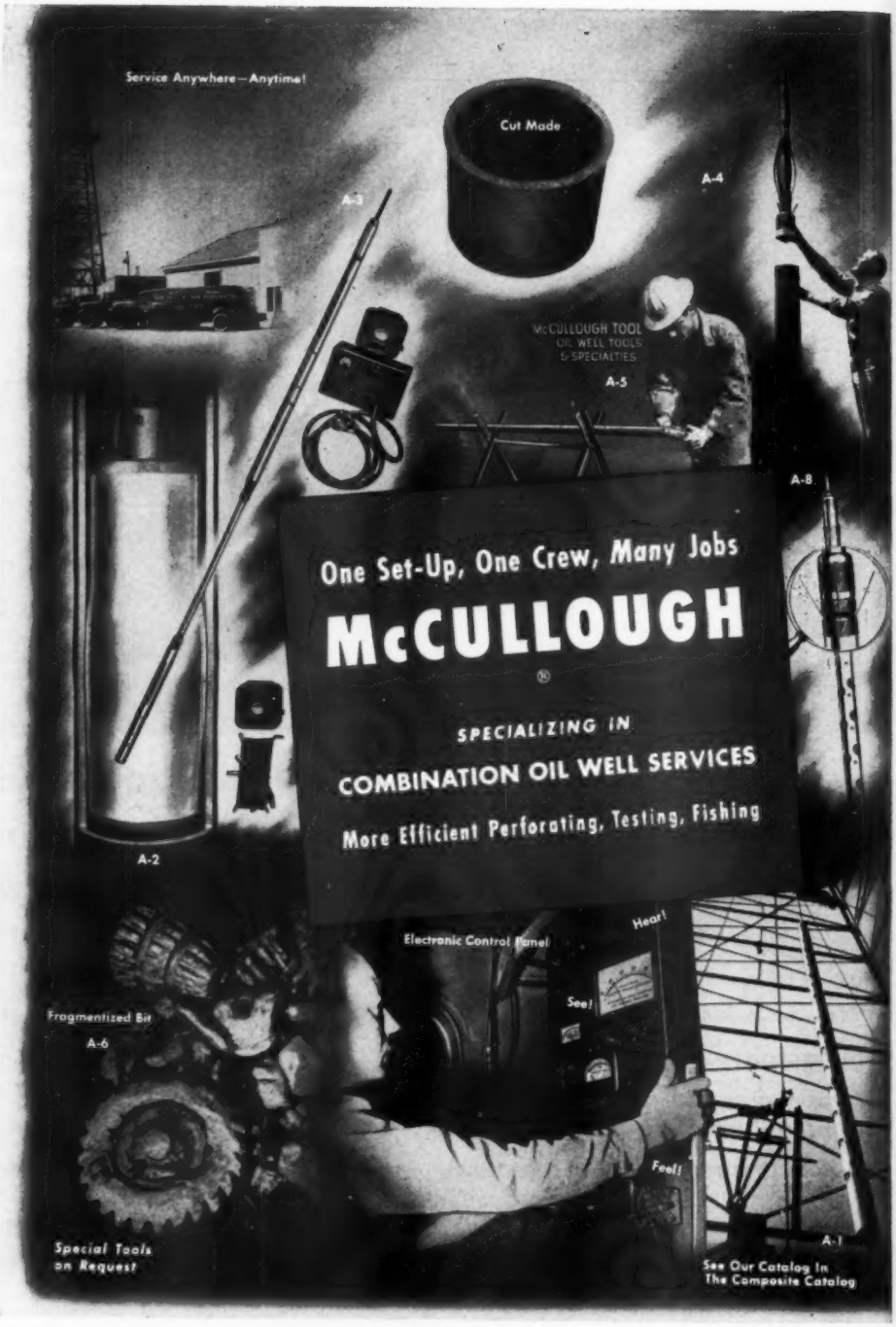

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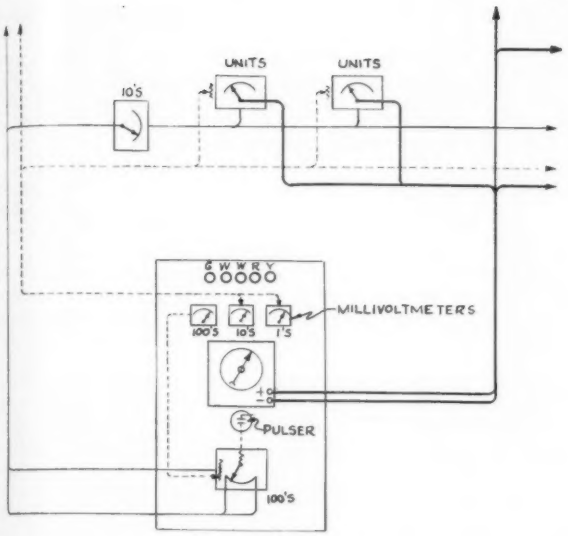

Fig. 2—Scanning system.

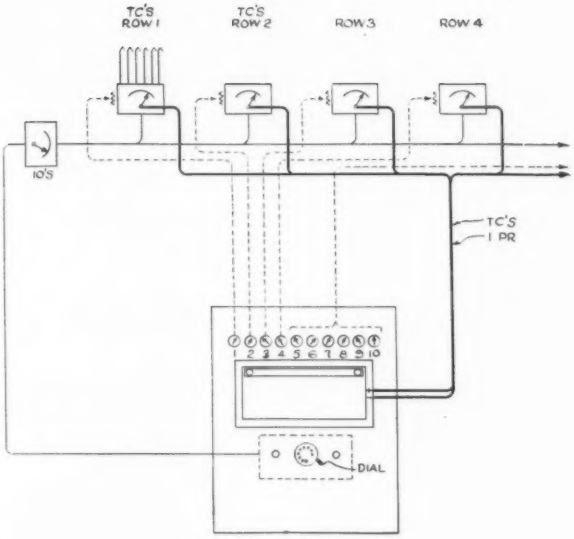

Fig. 4—Survey system.

tached a numbered segment that indicates the number of impulses delivered to that particular stepping switch from the remotely located unit. Here again three units are used to show the position of the digital unit.

The resistance system is used in those monitoring systems where the impulse is supplied mechanically, such as an automatic scanner which operates unattended. The feed-back impulse is preferred in those systems where the selection is made manually, such as the dial system.

In those installations where two types of thermocouples are used, an automatic switchover circuit is used which permits the operator to view only the correct scale for the type of thermocouple that is connected in the circuit.

Basic unit.—The basic unit of the system is a 10-point stepping switch with three banks of gold-plated contacts. An impulse coil drives three contact fingers. Each impulse advances the switch one point and is capable of receiving up to 30 impulses per second. A release coil allows the fingers to return to the open position through a spring drive whenever the release coil is energized. An additional contact is operated by the impulse coil armature when the impulse feed-back system is used.

The stepping switches are mounted on a bakelite panel which in turn is mounted on a steel panel with the necessary terminal blocks and the entire assembly is factory wired with necessary extension leads of copper wire, depending on final service. To date these unit assemblies have been wired for chromel alumel, iron constantan, and copper constantan thermocouples and copper for pressure transducers or motor operation.

Scanning system.—This system is basically the same as the dial system except that the manual operation of the dial is replaced by a timed impulse occurring every few seconds. The system is shown in Fig. 2. An intermediate switching circuit is interposed to reset the various tens and unit stepping switches as the scanner proceeds through its sequence.

The total number of circuits scanned is variable between 10 and 800. The measured points are fed into a self-balancing indicator with alarm or control mechanisms attached which may stop the progress of the scanner until it is manually reset by the operator.

The resistance type of position indicator is used with the scanning system. At the present time one scanning system on 160 tube-wall temperatures has been in operation for 7 months 24 hours each day without any interruption.

Continuous indicator.—Need for temperature indication on a graphical panel produced the continuous indicator. In this monitoring system a departure was made from the stepping switch with release coil to a switch with continuous circular drive, having 5 switch banks and 20 contacts per bank. The system is shown in Fig. 3.

Two of the switch banks connect thermocouples to a self-balancing indicator; the other three banks connect selsyn motors to a master selsyn which is positioned by the measuring drum of the indicator through a simple cam arrangement.

A motor-driven impulse timer controls two circuits, a d.c. circuit that advances the rotary stepping switch and connects a thermocouple to the self-balancing indicator, at the same time connecting a slave selsyn to the master selsyn in the indicator. A few seconds later, at which time the indicator comes to balance, a.c. power is applied to the selsyn circuit so that the slave will synchronize with the master selsyn. A.c. power is then removed and the next d.c. impulse given. Thus, one self-balancing indicator is used to continuously indicate 20 points on separate indicators.

The cam drive of the master selsyn makes possible a scale expansion of the 3-in. indicator in the center of the scale to the point where 5° can easily be read on a range of 500° to 1,500° F.

Survey system.—One process required the periodic comparison of eight temperatures in the same plane at 10 different zones in a vessel and

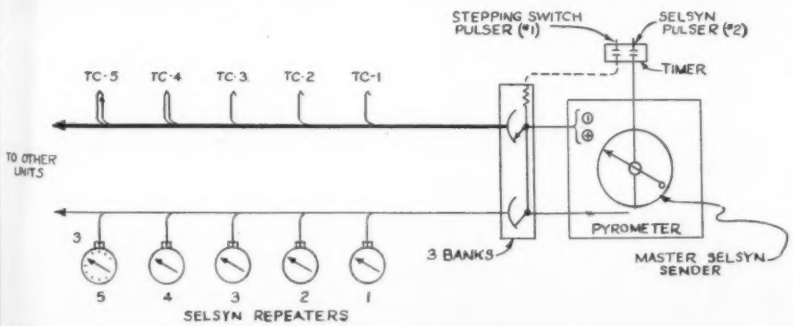

Fig. 3—Multiple continuous temperature indicator.

continuously to record the highest temperature in each zone.

Here the dial system was used with the variation that the output of a stepping switch was continuously connected to each point of a 10-point recorder representing the 10 zones; and eight thermocouples connected to the points of the stepping switch. The position of the stepping switches was indicated by the resistance method, using 10 small indicators located immediately above the 10-point recorder. The system is shown in Fig. 4.

With the addition of a few standard relays, any recorder point can be switched to any one of its eight thermocouples without disturbing the setting of any of the other points. At all times the arrangement of thermocouples connected to the recorder is indicated to the operator and is logged on the chart using a two digit system.

Control-point setting.—The use of a standard dial system as a means of setting the control point on remote pneumatic controllers has many interesting possibilities.

In this application selsyn motor drives are used for setting the control point in the remote controller. One master selsyn in the control room can be connected to any one of a large number of slave units and power applied to the system after the circuit has been set up.

In this case the master selsyn synchronizes with the slave driver, since the latter is operating through a gear train.

Electrical feed backs into three common buses to self-balancing indicators show the controlled variable, the control-point setting, and valve air pressure or position.

Remote Operation of Pumps

A system for remote selection of pumping units has long been needed to complete the instrumentation of large process units. Whenever a pumping unit has failed, it has been necessary for the operator to leave the control house and manipulate valves before a spare unit can be brought into service.

Using the dial system, the circuit is set up for a particular pump and the starting button pushed, which initiates a modified sequence control circuit to open an electric-operated suction valve, check suction pressure, start motor or turbine, check discharge pressure, and finally open an electric-operated discharge valve. All operations in this sequence are checked by a resistance system and indicated in the control room on a common indicator for all units.

The system described here is a proposal and has not yet been installed.

At the present time there are seven dial systems in operation, one scanning system, four survey systems, and one continuous indicator with 16 selsyns. The total number of measured variables in all these systems exceed 1,600.

There has not been one service adjustment made on any of this equipment since it was placed in operation. Some units have been in constant operation for 18 months in hazardous and corrosive atmospheres without any contact trouble.

One feature of all systems described here requires special mention. All switching is accomplished with the operating contacts carrying no load or potential.

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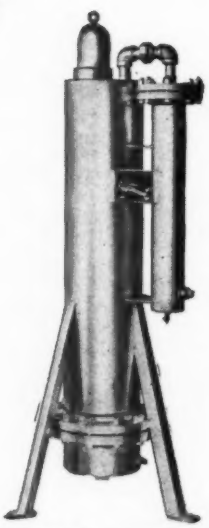

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CHEMICAL THERMODYNAMICS. By Frederick D. Rossini. Published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York. 514 pp. $6.

This is a complete study of chemical thermodynamics from the fundamental laws to the application of these laws to real physical and chemical systems. The first five chapters explain necessary background material, such as the present status of the scale of temperature, the fundamental constants, and the calorie and joule. The next 25 chapters give a comprehensive picture of modern chemical thermodynamics. The last five chapters deal with special applications, illustrative calculations, and sources of chemical thermodynamic data. The author provides 167 problems and 80 illustrations. Many of the illustrations are schematic diagrams which help clarify the more confusing aspects of thermodynamics. Also included are tables of fundamental constants and conversion factors.

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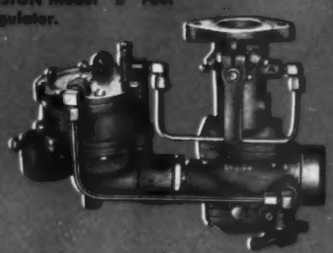

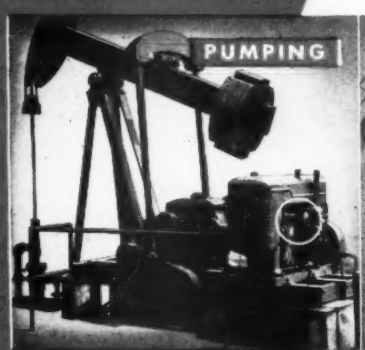

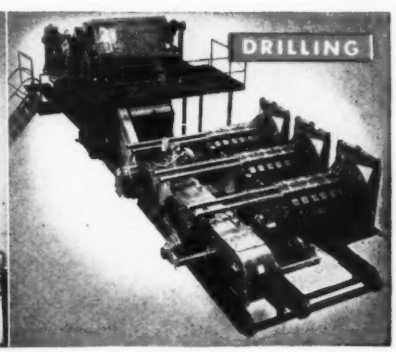

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PROGRESS in METALS

by W. L. Nelson
Consulting Engineer

Underground Corrosion of Metals, A Report by Bureau Of Standards

ALLOYS which have high resistance to corrosion under some conditions do not always stand up well during underground service. The particular problems raised by soil corrosion have been studied at the National Bureau of Standards for a number of years and some of the conclusions reached are reported in Technical Report 1434.

As a group, copper and its alloys with silicon, zinc, and nickel are highly resistant to corrosion in soils which are extremely corrosive to ordinary iron and steel. The copper alloys, however, differed rather widely in corrosion resistance, depending on environmental conditions. For example, in soils high in sulfides, copper corroded at an appreciable rate, but low-copper brasses were quite resistant. Low-copper brasses showed good resistance to corrosion as manifested by reduction in thickness and by the development of deep pits, but this advantage was offset by their susceptibility to dezincification. This type of corrosion can be prevented by a small arsenic addition.

High-Strength Steel

Small amounts of chromium, nickel, and molybdenum, which produce high resistance to atmospheric corrosion in high-strength steels, were found to contribute little to their corrosion resistance underground. This difference in behavior is attributed to soil conditions which do not favor formation of the tight, adherent rust deposits which protect against further corrosion.

A number of alloys were found to give long service underground provided reasonable allowance is made for reduction in wall thickness by corrosion. Certain steels containing high percentages of chromium and nickel showed no appreciable weight loss after the maximum exposure period. But results obtained on small test specimens are not necessarily applicable to large structures of the same material.

In certain soils where the corrosion rate of a metal rapidly diminishes, it is sometimes possible to secure infinite life for piping by increasing wall thickness. Unless a substantial increase in useful life can be obtained, however, the cost of the extra thickness would not be justified and some other means of combating corrosion would be indicated.

Creep Strength of Lead

LEAD is used extensively in petroleum refineries as a lining material, and it is troublesome because it stretches or creeps. It must be supported at short intervals of length to avoid stretching or bulging out of position.

Tables 1 and 2 were taken from the paper of J. Neill Greenwood, "The Influence of Vibration on the Creep of Lead" which was presented before the American Society for Testing Materials in 1949. These show the creep stresses of industrial leads at three temperatures and at different rates of extension up to 6 per cent (Table 1) and the stress (static) to cause a 1 per cent extension in 1 year as a function of temperature (Table 2).

TABLE 1
Approximate Creep Yield Data for Several Industrial Leads Under Static Conditions

Extension in 1 year (%)	Stress, psi. At 68° F.	At 120° F.	At 150° F.
0	60	...	60
1	297	120	149
2	309	260	165
3	320	280	185
4	335	296	203
5	352	308	217
6	365	318	238

TABLE 2
Approximate (Static) Stress to Cause a 1 Per Cent Extension in 1 Year for Various Leads at Different Temperatures

Temp.	Stress for a 1 per cent extension in 1 year, psi. Pure and Cu lead	0.02-0.05% Ca lead
60	303	620-745
80	292	580-702
100	265	515-655
120	235	460-608
140	190	385-548
160	125	305-492

Fatigue Limit of Plated Steel

ALTHOUGH chromium plating reduces the fatigue limits of steels, a recent study by Hugh L. Logan of the National Bureau of Standards shows that the effect is less pronounced under some conditions than others. Sponsored by the Bureau of Aeronautics of the Navy Department, the investigation was concerned with

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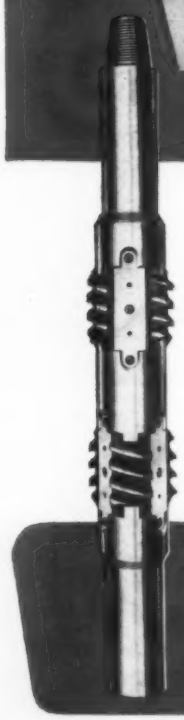

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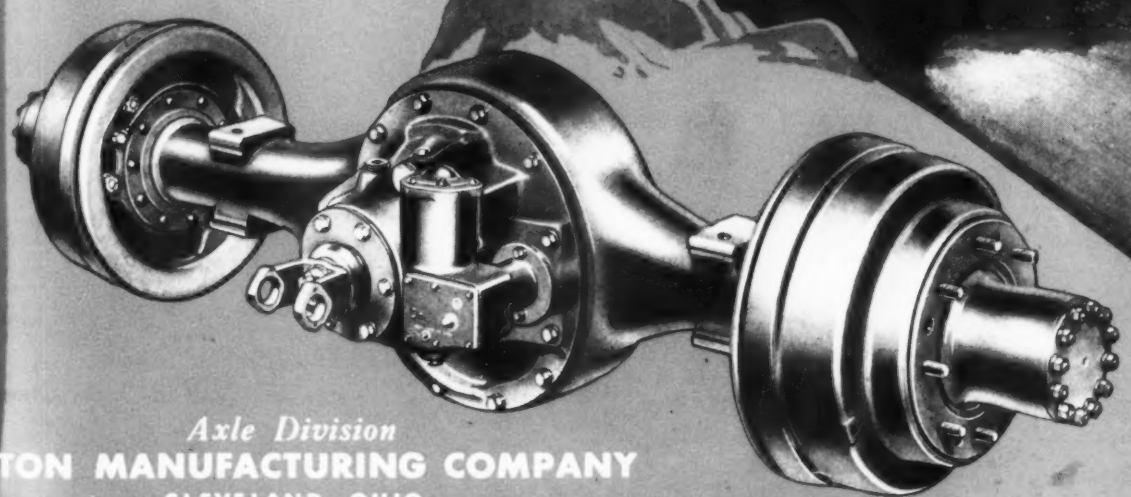

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In general, the reduction in fatigue limit increased with increased hardness of the steels. For steel of a given hardness, the fatigue limit decreased with increased temperature of the plating bath. Plate thickness had little effect on the fatigue limit of specimens plated at 131° F. and a current density of 350 amp. per square foot, but no generalizations can be made regarding the effect of this factor at other temperatures and current densities.

Plating Partially Removed

Fatigue limits of specimens plated and subsequently ground to remove part of the plate were found equal to or greater than those of specimens originally plated to the same thickness as the ground specimens and tested as plated. Other tests showed that interruptions of the plating process had no effect provided proper precautions were observed.

The effect of fatigue limit of heating chromium-plated steel to expel hydrogen from the deposit was also investigated. Results showed that fatigue limits of quenched and tempered plated specimens decrease to minimum values for heating temperatures between 210° and 570° F., and thereafter increase with higher heating temperatures.

Further tests seemed to indicate that the decreased fatigue limit obtained by heating plated specimens at about 400° F was due to increased tensile stresses induced in the chromium plate. For higher heating temperatures it is believed that the contractive forces in the chromium produce enough tensile stresses to cause plastic flow or rupture of the plate, thus relieving the residual tensile stresses in it and raising the fatigue limit.

Residual stresses are believed to be a primary cause of the adverse effect of chromium plating on fatigue limits of steel. No simple relationship between the fatigue limit and amount of hydrogen remaining in the plate after baking was found, and further evidence indicated that cracks in the plate were not the principal cause of reduced fatigue limits.

An abstract taken from the October 1949 issue of Materials and Methods.

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Parting or cutting of metal, usually cold, between sharpened blades. Vertical or alligator shears are the equipments used. Shearing is used in the preparation of stock for forging, in the cutting of scrap, etc.

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Fig. 1—Cut-away view of reducing size WeldOlet with welding outlet in place. The external rib and wide bases or footings of WeldOlets eliminate the need for extra supports to take care of bending or vibrational stresses at crotch section, the point of greatest stress.

Fig. 2—Note blending of ear portion of welding fitting to run pipe. Extension of weld metal below inside scarfed portion of pipe insures all sections of joint greater than pipe wall thickness.

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Capillary-Pressure Method of Interstitial Water Determination

and Related Topics

by Walter Rose*

This article discusses from a new point of view the concepts underlying the capillary-pressure method of determining interstitial water, and, more broadly, to stimulate the interest of geologists in this phase of applied reservoir engineering which heretofore has been the concern principally of petroleum engineers. Thus it will be seen that many of the unsolved aspects of capillary pressure experimentation present problems which are basically geological. Moreover, although the determination of interstitial water is a necessary prerequisite to reservoir-engineering studies, it can also be regarded as an exploration tool which will tell whether or not a drilled well should be completed.

ACCORDING to convention the terms "interstitial water" and "connate water" are used interchangeably to refer to that aqueous phase, usually of ancient marine origin, which is found to coexist with the hydrocarbon fluids as one of the saturants of the interspaces of petroleum reservoir rock at the time the reservoir is discovered. However, inasmuch as one problem of concern is the determination of the water content of the reservoir at the time of initial exploitation, it appears unnecessarily restrictive to limit from consideration waters which have infiltrated into the formation during geologic time. Thus in actuality the concern is with the interstitial water which may be of connate origin or secondary origin.

The foregoing definition of the reservoir water content to be determined by the capillary pressure method is suggestive of a major difficulty which will be encountered when laboratory work is undertaken. It will be seen that the capillary pressure experiment involves simulating in the laboratory the processes of accumulation that occur in the reservoir over geologic time. Thus since the accumulation processes must be known before they can be simulated, the geologist's aid is required to supply the information which will determine the nature of the laboratory experiment to be undertaken.

It is beyond the scope of this article to deal extensively with the merit of the other methods of interstitial water determination.* The widespread usage of the capillary pressure method†, as indicated for example by Muskat's[20] recent discussion of the subject (c.f. Chapters 3 and 7), bears sufficient evidence of a general acceptance of the underlying theory as being pertinent to the problem of describing fluid distribution in petroleum reservoirs. An attempt will be made here, therefore, to justify this general acceptance without relying on experimental proof where connate-water values obtained by various independent methods are shown to compare favorably.

It is believed that an analysis of the capillary-pressure method itself will be of value, because it is often advantageous to have core samples restored to some original reservoir state (with respect to the distribution of the immiscible fluids within the pore spaces) in addition to simply knowing the connate-water content. Thus an objective of a core analysis is to provide information about the characteristics of the petroleum reservoirs represented by the core samples in order to facilitate elucidation of such matters as reservoir reserves and reservoir recovery of oil and natural gas. Inasmuch as capillary-pressure phenomena affect the distributions of the reservoir fluids (viz. oil, gas, and brine) within the pore spaces, it is seen that investigation of these phenomena should provide information bearing on the economically important problems of reserves and recovery, as well as on conservation problems.

Estimates of petroleum reserves are based on a knowledge of porosity and connate-water saturation, or more particularly, on a determination of the percentage of the total void space which is available for saturation by the hydrocarbon fluids (viz. liquid petroleum and natural gas). Both theory and experiment show that the amount of hydrocarbon fluid saturation that can be developed in an initially connate-water-filled reservoir depends on the balance developed over geologic time between the forces responsible for the hydrocarbon accumulation and the capillary forces opposing the displacement of the connate water.

Although the nature of the accumulation forces is obscured by uncertainties related to the origin of petroleum and to the mechanisms of migration from the source bed and accumulation into what later becomes the reservoir, it suffices for the purposes of theoretical analysis to represent the accumulation processes as manifestations of gravitational effects. The capillary forces clearly are manifestations of the intermolecular attractions between the wetting and nonwetting fluids and the confining solid matrix phase, and are measured in terms of the interfacial tension, contact angle, and pore dimensions containing the interfaces of contact between immiscible phases. In suggesting above that the capillary forces oppose the drainage of the connate water, the tacit assumption is made that the connate water is to be regarded as the wetting liquid. (c.f. Muskat,[20] p. 311).

On the other hand, estimates of petroleum recovery are based on mixture flow considerations, where again capillary pressure phenomena are of importance in that they affect rates of recovery and determine amounts of fluids which can be recovered by a given process of displacement. In this instance, it is the interplay of capillary forces with the dynamic forces initiating the fluid displacement and fluid flow which must be considered.

Although it would be desirable to treat the transient as well as the steady-state aspects of petroleum re-

*Department of Petroleum Engineering, University of Texas. A sponsorship of the Texas Petroleum Research Committee, George H. Fancher, director, as contribution No. 3.

*As a matter of general information, the reader is referred to Archie's scheme based on interpretation of electric log resistivity data[1 2 9 11 21 22]; to the various schemes used on direct analysis of core water content as reviewed in Muskat's book[20]; or to some of the more recently proposed schemes, such as Purcell's[6 21], Slobod's[26], or Messer's.[18]

†Since the preparation of this manuscript two books have appeared with further informative treatment of capillary pressure subjects, which confirm in most details the views expressed by Muskat (op. cit.) regarding the importance of the capillary pressure method of connate water determination (c.f. Pirson, Elements of Oil Reservoir Engineering, McGraw-Hill, 1950; Russell and Dickey, Chapter 32, Trask's Applied Sedimentation, Wiley, 1950).

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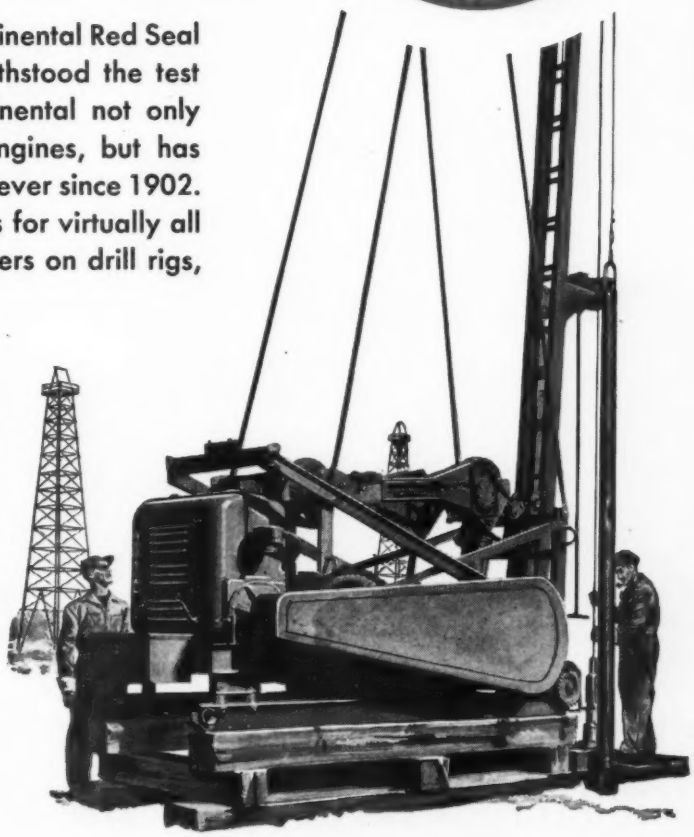

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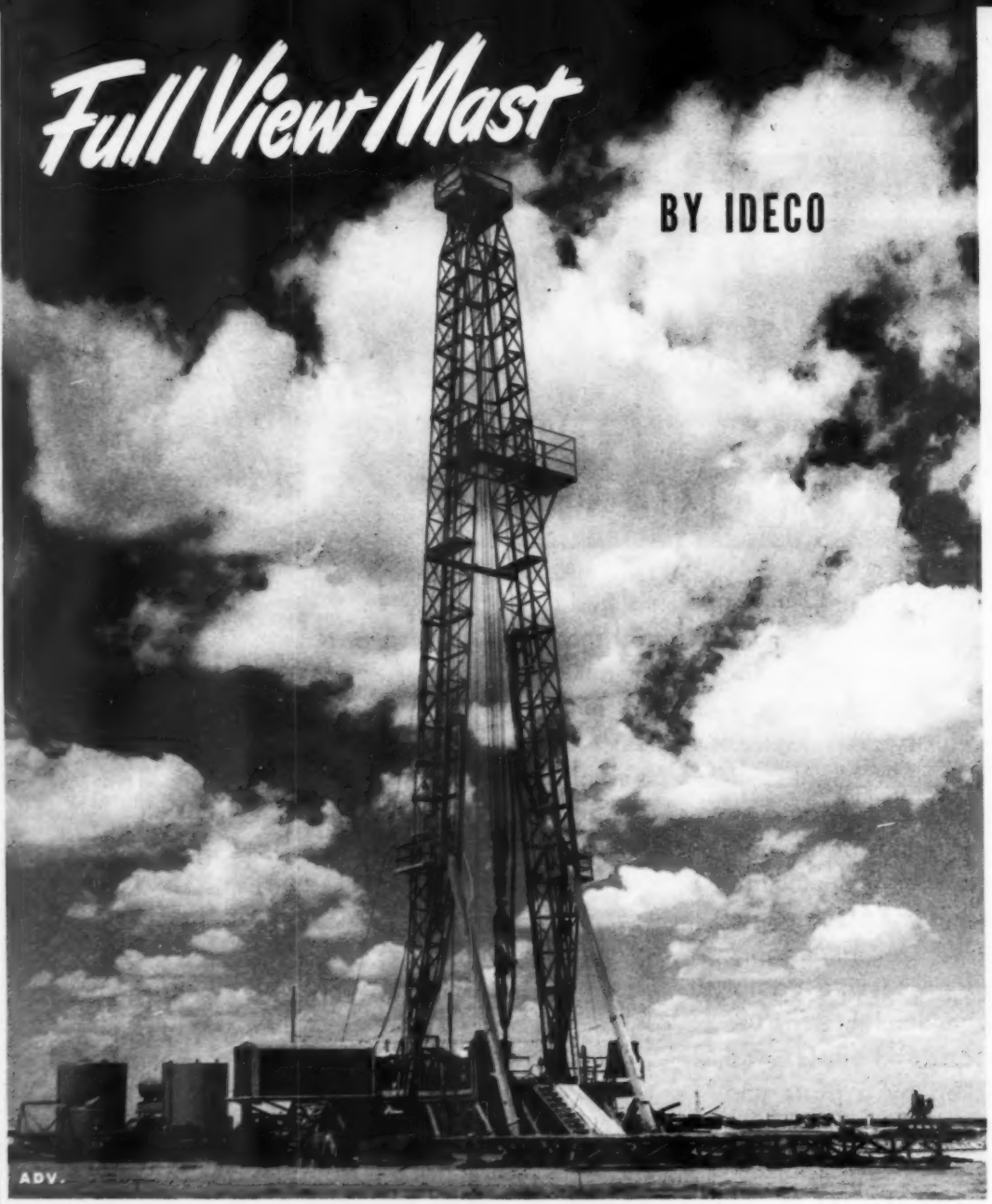

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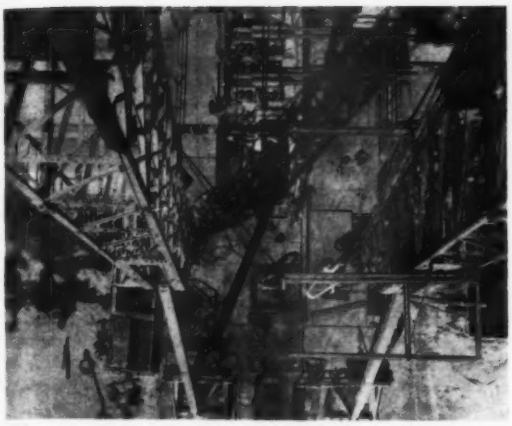

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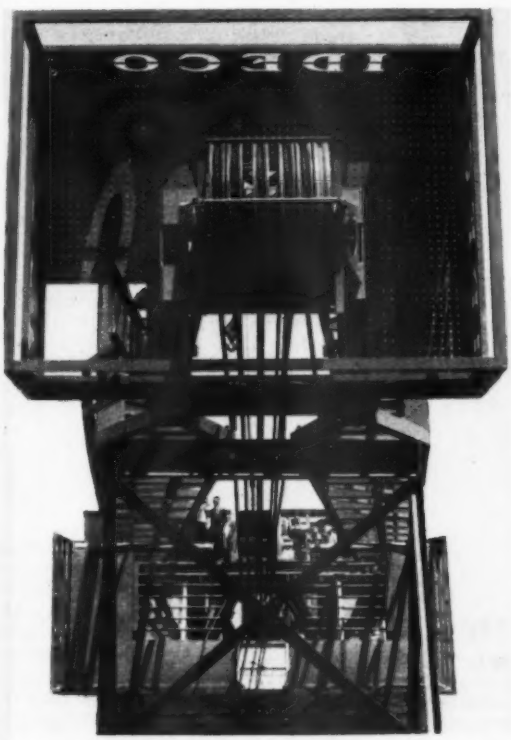

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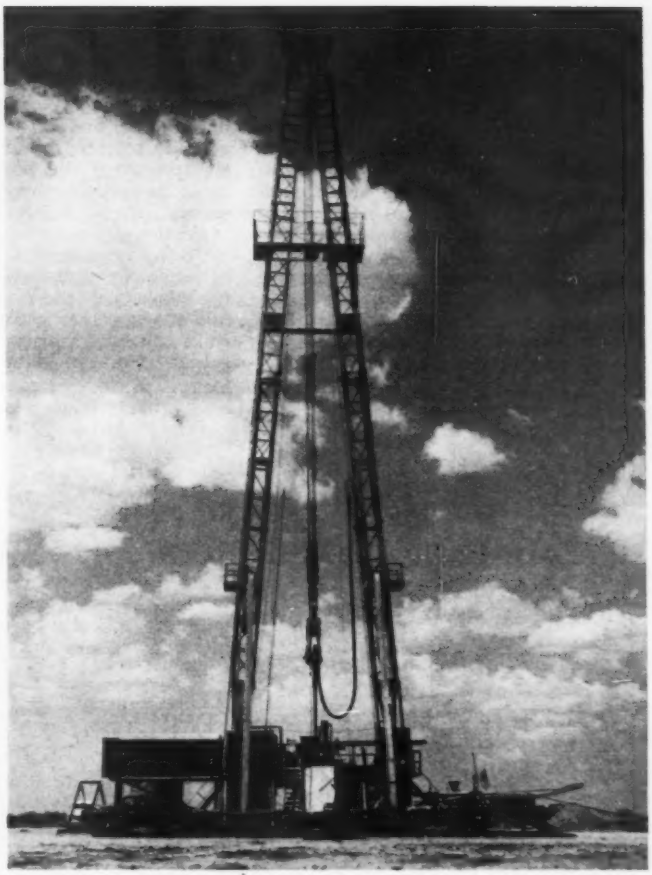

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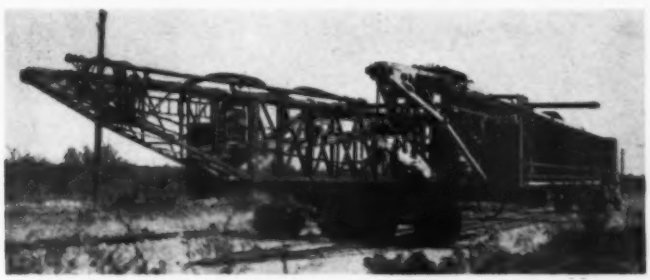

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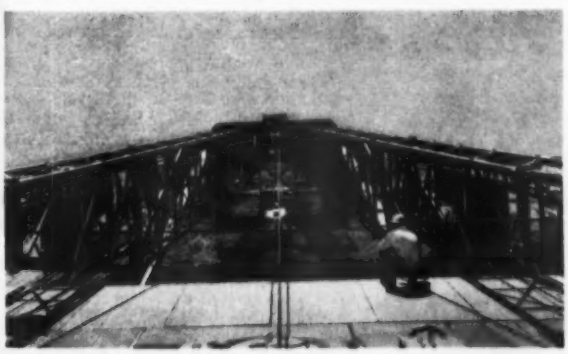

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covery, present methods of analysis and present techniques of laboratory experimentation are of little help in solving the transient problems, and the expedient of treating transients as a succession of steady states is the solution usually attempted. It will be seen that the capillary-pressure method as outlined herein is a prerequisite to the laboratory investigation of steady-state mixture flow studies, and provides an indication of the maximum theoretical recovery of the hydrocarbon fluids.

Neglecting economic considerations for the moment, it is implicit in the foregoing discussion that a major objective of core analysis is to determine the capacity of the reservoir to yield recoverable hydrocarbons. The measurement of porosity simply indicates the capacity of the reservoir to hold fluids, and the measurement of connate water can be regarded as a refinement of the porosity measurement in that the capacity of the reservoir to hold hydrocarbons is then indicated.

On the other hand, the measurement of effective permeabilities indicates the capacity of the reservoir to transmit the separate components of the fluid mixture saturating the pore spaces. The importance of the capillary-pressure experiment, then, in addition to its use for connate-water determination, is its use in the preparation of core samples with proper interspatial fluid distributions for subsequent studies of hydrocarbon recovery.

Capillary Pressure Experiment*

It has been suggested that both during the accumulation of hydrocarbons, and later the production of hydrocarbons from the reservoir, the immiscible fluid saturants become distributed according to well-defined† capillary-pressure processes; and that the fluid distributions which finally obtain determine along with porosity the potential hydrocarbons reserves, and determine along with permeability the potential reservoir productivity. Thus capillary-pressure experimentation refers to laboratory procedures where these reservoir capillary-pressure processes are simulated to provide fluid distributions in core samples analogous to those which obtain in the reservoir.

From both the theoretical and experimental standpoint a major difficulty which is encountered in the investigation of capillary-pressure phenomena is due to the complex hysteresis effects which frequently obtain. For instance, it will be clear that capillary effects will manifest themselves in a given pore space only when an interface of contact between immiscible fluids exists within this pore space. Otherwise, when the pore space is filled only with a single (homogeneous) fluid or miscible fluid mixture there are no possibilities for variable fluid distribution, and in this case interfacial tensions do not affect fluid transport.

It follows that the prior fluid distribution history of the system comprising the given pore space determines in a somewhat accidental manner whether or not at some given time of interest a fluid interface will be found within the given pore space. In this respect the ultimate fluid distribution characteristics of the pore saturants become dependent on previous events, resulting in hysteretic uncertainties except in special cases

*For comprehensive material on the rationale of the capillary pressure experiment the reader is referred to the basic papers of Leverett[16]; Hassler, Bruner, and Deabl[14]; and Rose and Bruce.[33] It will be found that much of the material in these references is reviewed by Muskat.[20]

†In referring to these processes as well defined it is not implied that in every case they are fully understood and subject to simple description. On the contrary, most capillary-pressure phenomena observed in porous media are exceedingly complex and often best described empirically owing principally to the heterogeniety of the porous matrix structure. However, inasmuch as these phenomena are at least qualitatively in accord with basic physico-chemical considerations, they are referred to as well defined in that they are not believed to be anomolous, in spite of the uncertainties and difficulties which are encountered when quantitative descriptions are attempted.

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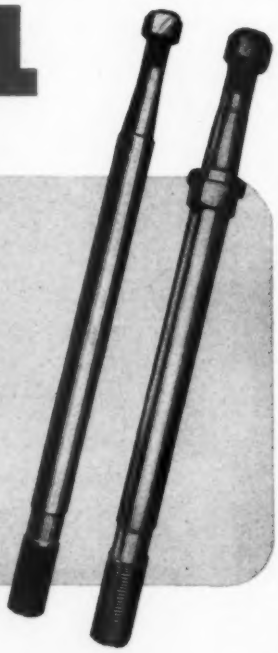

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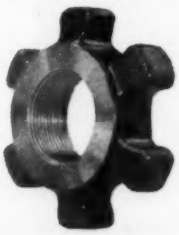

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where the prior history has followed some well-defined pattern.

Regarding the accumulation of oil in a reservoir, the assumption is sometimes made that the development of the ultimate oil saturation involves only a drainage of the connate water initially present, which continues over geologic time until each interface of contact between the invading oil and the receding water becomes statically fixed in the particular pore space where a stable balance can obtain between gravity and capillary forces.

In this particular case, one need not be concerned with the fact that at any given level in the reservoir interfaces of contact are not necessarily found in every pore space where the aforementioned balance could conceivably obtain, because the drainage process which has been postulated as descriptive of the prior history of the system simply does not provide for the existence of interfaces, for example, in pore spaces which must be drained through narrow-necked openings. The result is that the well-defined drainage process leads to a single type of fluid distribution, which in fact can be shown to be a limiting distribution in terms of the other hysteretic possibilities.

Admittedly, the postulation of a drainage process as wholly descriptive of oil accumulation in every reservoir can be an unjustified simplification, since inbibition effects are believed sometimes to affect oil accumulation.[19] Moreover, in considering the dynamics of oil recovery, other complex hysteresis effects are to be anticipated, not only because of the greater variety of prior distributions that can precede any given moment of interest in dynamic systems, but also because of hysteretic contact angle effects. To the extent that these dynamic processes of fluid flow and displacement necessarily precede the attainment of the static equilibrium fluid distributions of interest, it is indicated that the capillary-pressure experiment must adequately provide for the simulation of the entire process of oil accumulation if reliable results are to be expected.

Following Rose and Bruce[23] it is noted that the principal objective of capillary-pressure experimentation is to provide a laboratory model of the reservoir of interest. The core sample represents this reservoir or some significant portion thereof, implying that multiple core analysis will be required when heterogeneous reservoirs are being considered. Further, the objective is to provide boundary conditions and processes of fluid displacement simulating or approximating those occurring in the natural reservoir, so that the resulting fluid distributions which are caused to obtain will be indicative of those characterizing the prototype reservoir.

Aside from the difficulties described above associated with the hysteresis effects, other limitations in attempting to undertake model experimentation are self-evident. Thus, one must satisfy the theoretical requirement of knowing the pertinent facts characterizing the prototype reservoir before the model can be constructed.

For example, although it has been noted that postulation of a simple drainage process as descriptive of oil accumulation may be questioned, and although postulation of the more reasonable process involving both drainage and imbibition leads to great difficulties in view of the hysteretic complexities which then are encountered in experimentation, nonetheless in principal a satisfactory laboratory-model experiment can be performed if the processes characterizing the prototype are fully understood. However, one must also satisfy the practical requirement of being able in the physical sense to provide the instrumentation necessary to set up the model and to make the required experimental measurements.

As an example of the latter it is usually found impracticable to simulate in the laboratory the condition of rock matrix stress which characterized the core sample when it was a part of the prototype reservoir and which was due to overburden compaction. To the extent, therefore, that matrix stress affects pore configurational character, one can expect to obtain an error in laboratory measurements.

In the interest of brevity and in the interest of avoiding speculative argument a complete evaluation of these matters will not be given. It is recognized that many of these matters, however, are of crucial importance in determining the practicability of obtaining significant results from capillary pressure experiments, and that in a sense it is begging the question to assure the experimenter the self-evident fact that if the experiment is done properly a correct result will be obtained.

In some instances at least, it appears as though a knowledge of how the experiment should be performed implies on a priori knowledge of the desired result, thus obviating the necessity of the experiment. In these connections, however, it is possible to emphasize the important role of the geologist in supplying to the petroleum engineer the available pertinent information about the process of accumulation which is to be simulated in the laboratory experiment.

The experimenter still has to decide how to select core material completely to represent the reservoir of interest, how to assure that reservoir conditions of interfacial tension, contact angle, etc., will be simulated in the laboratory model, and finally how to provide for the instrumentation and control so that the laboratory measurements will have the required significance.

The reader is referred to Muskat's review of the subject[20] for reference to the original literature describing the various proposed techniques of capillary-pressure experimentation. Certain supplementary comments will be presented here as a matter of information.

The core samples used in the capillary-pressure experiment, as representative of the given reservoir of interest, are generally processed in the field at the point of recovery, and then shipped to the laboratory for additional preparation. The field processing usually involves selecting samples of the recovered core after preliminary geological analysis has been made; identifying the portions selected according to recovery depth, size and orientation; and preparing the cores for shipment to the laboratory.

The amount of core sample selected, of course, varies according to the amount of information desired and according to the heterogeniety of the reservoir being studied, but generally will not greatly exceed the amount of sample normally required for routine determination of porosity and permeability. The special requirement in field processing is to minimize weathering of the core samples because it is found that drying of the pore saturants can alter the wettability of the interstitial surfaces. Moreover, when the cores have been recovered by special muds (e.g. oil-base muds or aqueous muds with tracers) and laboratory analysis is to be made of fluid saturation in situ, it is particularly necessary to avoid fluid loss.

In view of the above considerations, it appears to be good practice to store the selected cores in an environment of the drilling fluid (or some other inert fluid such as diesel fuel, etc.). The laboratory processing of the core samples which precedes the capillary pressure experiment needs only involve shaping the cores and partial or complete removal of the reservoir fluid saturants and mud contaminents. In addition, certain routine core-analysis tests can be undertaken before the capillary pressure experiment if alteration of core properties is avoided. Among other things, this latter limitation prevents use of retort methods for fluid saturation, mercury-penetration methods for porosity, liquid-permeability methods which induce dislodgement of interstitial particles or pore plugging by suspended solids, and solvent-extraction methods which alter interstitial surface wettability characteristics.

Applications of Capillary-Pressure Experimental Data

During the course of capillary-pressure experiments several types of measurements can be made to obtain data for interpretation. These include: (1) measurements of fluid saturations analogous to those occurring in the transition zones of petroleum reservoirs interconnecting gravitationally segregated immiscible fluids; (2)

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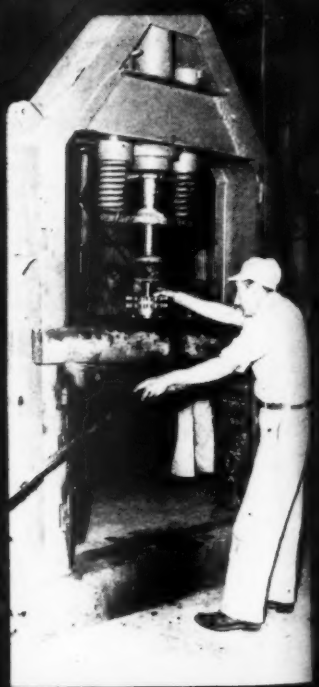

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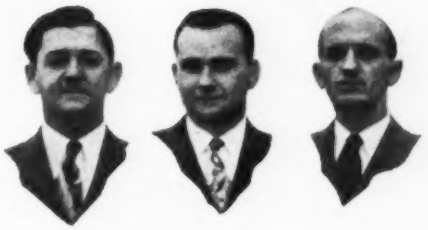

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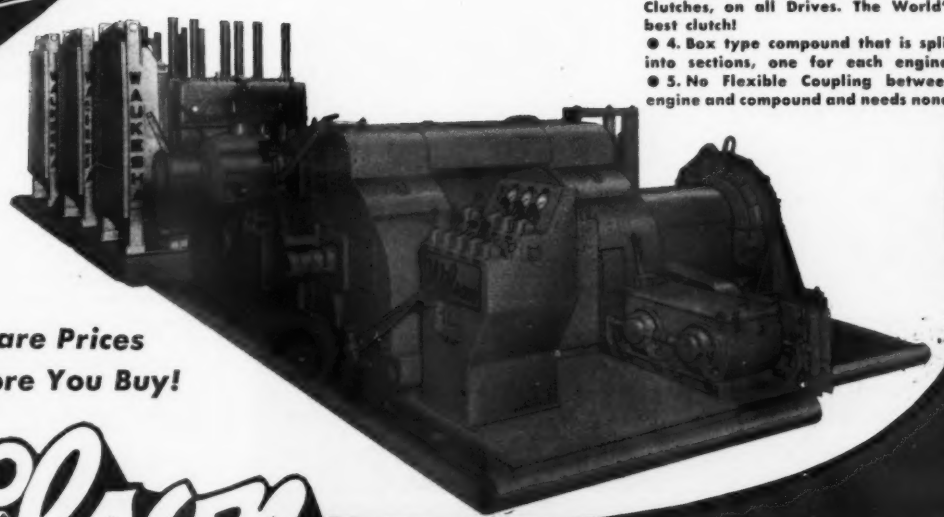

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measurements of minimum fluid saturation retaining fluid phase continuity, closely analogous to the pendular configurations of connate water in the reservoir above the transition zone or to the immobile and therefore nonrecoverable configurations of oil and gas characterizing reservoirs at hydrocarbon depletion; (3) measurements of displacement pressures and other parameters reflecting on rock textural characteristics; and (4) measurements of core electrical conductivity parameters useful for well-logging interpretation.

Capillary pressure curves refer to graphical plots of the capillary pressure obtaining at the interfaces of contact between immiscible fluids and the saturation of one of the fluids (e.g. the wetting liquid saturation usually is taken as the independent variable). With few exceptions[30] all the curves reported heretofore in the literature apply to porous media saturated with only two fluids, such as water or brine as the wetting liquid and some gas or hydrocarbon phase as the nonwetting fluid. It will be seen, however, that curves descriptive of fluid distribution in reservoirs where as many as three immiscible fluids are cosaturants of the voids will be of great practical interest, because of the frequent coexistence of oil, gas, and connate water.

Historically, analysis was first given to the quantitative aspects of capillary pressure curves by Haines[13] whose classical data and theoretical interpretation are still accepted as essentially correct. Smith[27] shortly thereafter provided an ingenious and more complete theoretical analysis of the problem, applicable, however, in a quantitative sense only to porous media comprised of random-packed spheres of uniform size, as checked against the early sand-column-drainage experimental data of King.[16] It is interesting to note that the later papers of the petroleum technologists[7, 14, 16, 19, 21, 29] largely express concepts implicit in or otherwise compatible with Smith's analysis.

Unfortunately, but wholly explicable in terms of the inherent limitations of theoretical analysis, the more recent authors have not found it possible to give the complete formulation of capillarity effects in complex porous media such as consolidated sandstones and limestones which Smith provided for the simpler sphere systems (c.f. attempts by Buckley and Leverett[6] and by Cardwell and Parsons.[8] In fact, it has come to be generally recognized that the quantitative description of fluid distributions in porous media is necessarily an empirical problem.

In order to arrive at a value of capillary pressure to be associated with the appropriate saturation value, when a capillary pressure curve is being determined, the following for-

mulation is invoked (at least implicitly):

$$(\sigma C) > \text{or} < [(\gamma_w - \gamma_n)gh] \quad (1)$$

Where

σ = interfacial tension obtaining at the interfaces of contact between the wetting and nonwetting fluid

γ_w and γ_n = the densities of these fluids, respectively

C = the curvature of the given interfaces of contact

h = the vertical distance between the interfaces of interest and the hypothetical point in the system where capillarity requires an interface of zero curvature to exist

g = the gravitational acceleration constant.

The terms of Equation 1 have the dimensions of pressure; the first term being proportional to the capillary forces of attraction which tend to hold the wetting liquid preferentially in the smallest pores, the second term clearly being proportional to the gravitational force which effects the segregation of immiscible fluids of different densities. Thus, from Equation 1 it can be shown that in the event:

$$\gamma_w > \gamma_n$$

a drainage of the wetting liquid will occur when:

$$\sigma C < (\gamma_w - \gamma_n)gh$$

and an imbibition will occur when*:

$$\sigma C > (\gamma_w - \gamma_n)gh$$

On the other hand, when:

$$\sigma C = (\gamma_w - \gamma_n)gh$$

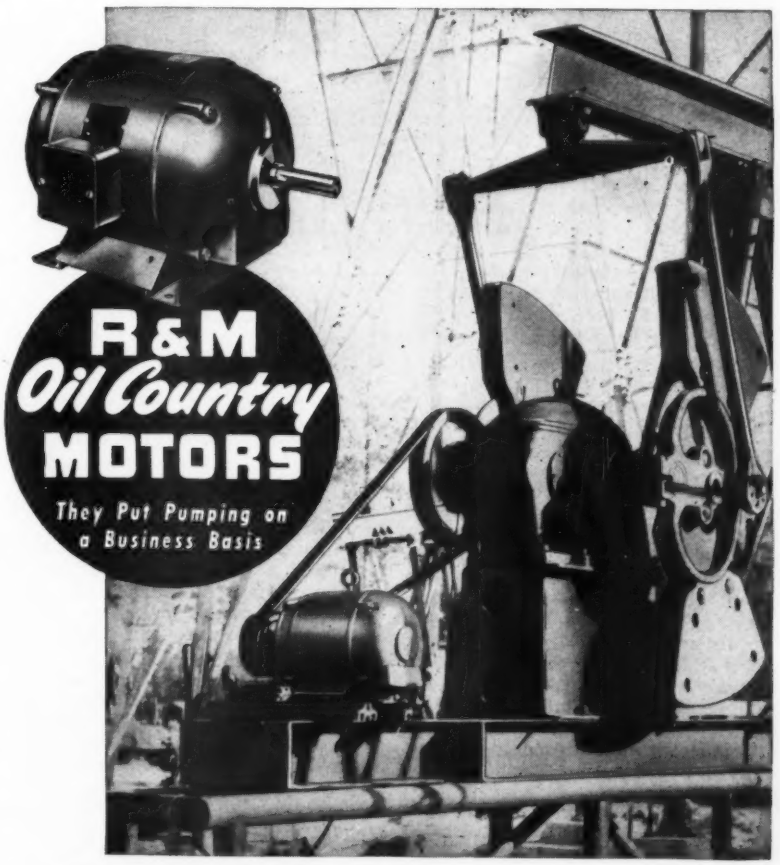
a state of static equilibrium obtains and no displacement (drainage or imbibition) of fluids occurs. In fact, the desired value of capillary pressure, P_c, defined as the difference in pressure between nonwetting and wetting fluid obtaining at the interfaces, is described then by:

$$P_c = \sigma C = (\gamma_w - \gamma_n)gh \quad (2)$$

Examination of the terms in Equation 2 emphasize the indeterminateness of P_c by theoretical means. Thus whereas σ, $(\gamma_w - \gamma_n)$, and g are constants for a given experiment, no preassigned value can be given for C or h. Moreover, since P_c is to be associated with some value of saturation (e.g. ρ_w, the saturation of the wetting phase) the additional difficulty is encountered of expressing C in terms of ρ_w before a complete formulation can be given for the capillary pressure curve. In this connection, it will be expected that, qualitatively, in a given system of given texture high values of C usually will be associated with low values of ρ_w, although again hysteretic uncertainties will provide exceptions.

It may be concluded therefore that no unique theoretical description can be given for capillary pressure phenomena in porous media such as that arrived at by Smith (loc. cit.) for simple sphere systems. In fact, one makes only implicit use of Equations 1 and 2 in the experimental evaluation of P_c; which is to attempt to observe the interfacial difference in pressure between nonwetting and wetting fluids, according to the definition of P_c based on this pressure difference. However, in experimentation these pressures necessarily are measured externally (i.e. in the external fluid chambers which contain the wetting and nonwetting fluids in communication with the saturants of the pore spaces) at that time when Equation 2 seems to hold as will be evidenced by the observed cessation of fluid displacement. At this time a value of ρ_w also is obtained experimentally, and in this manner a series of P_c and associated ρ_w values are determined to provide

*The convention will be adopted that a drainage process refers to the condition where the wetting liquid saturation is decreasing and the nonwetting saturation is increasing in the portion of the porous structure of interest. Similarly, an imbibition process refers to an increasing wetting phase saturation and decreasing nonwetting phase saturation (i.e. imbibition is the reverse of drainage). It will be noted that rate of displacement considerations determine whether or not in a large porous body (for example, a reservoir) which is draining (or imbibing) in one portion will be everywhere draining (or imbibing), particularly if nonuniform saturation distributions obtain. This latter is due to the dependence of effective permeability on saturation and saturation distribution.



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the basic data descriptive of the capillary-pressure curve of interest.

It will be instructive at this point to consider certain possible sources of error in this method of determining capillary-pressure data. Equation 2 implies that for the externally measured pressure difference between the fluids wetting and nonwetting to equal P_c; (1) fluid continuity must obtain between the interstitial fluids at the interfaces and the external fluids as has already been discussed by Muskat[19]; and (2) static equilibrium conditions must obtain, since if the fluid interfaces are in motion viscous resistance effects will result in the externally measured pressures being different from the interfacial pressures according to Darcy law considerations. This latter consideration can be analyzed in some detail.

In the first place it can be shown by analogy to the related problem of rate of imbibition in capillary tubes[9] that an infinity of time is required for the inequality expressed by Equation 1 to reach the static equilibrium condition indicated by Equation 2. This is because as the capillarity and gravity forces tend to balance each other, the residual force difference which effects further balance becomes vanishingly small, approaching zero in a manner similar, for instance, to the discharge of a condenser.

The complication arises from the fact that in the laboratory many fewer orders of magnitude of time are available to approach equilibrium than in the reservoir where geologic time is operative. Thus it is probable that strictly speaking true static equilibrium conditions never obtain in the laboratory experiment, and geologists are quite aware of the questions that have been raised about attainment of true equilibrium in petroleum reservoirs.

In these connections, it is evident that it is desired only to simulate the same degree of reservoir equilibrium attainment in the capillary pressure experiment, and in specific cases this objective may be satisfied in principle by use of Equation 3, which gives the fractional error introduced into the measurement of P_c by using the externally measured pressures instead of the internal interfacial pressures. Equation 3 is:

$$E = (Q/P_c)(R_n + R_w + R_B) \quad (3)$$

Where

Q = the volumetric rate of displacement (in cc. per second)

P_c = the capillary pressure (in atmospheres)

R_n = the resistance offered by the core matrix to the flow of the nonwetting fluid (in atm.-second/cc.)

R_w and R_B = the resistances offered by the core matrix and barrier, respectively, to the flow of the wetting liquid.

Although Equation 3 is an exact formulation it is not amenable to simple evaluation because of uncertainties regarding values to assign to the parameters R_n and R_w in particular instances. For qualitative interpretation purposes, however, Equation 3 is quite informative, and it is seen that as the rate of displacement approaches zero the error becomes zero, but that as the saturation of either the wetting or nonwetting fluid approaches minimum (discontinuous) values the error increases due to the increase in resistance to fluid flow.

Equation 3 is derived by assuming that the core sample is made up of two portions in series, one being that portion saturated with the nonwetting fluid displacing phase and having the property R_n, and the other being that portion saturated with the wetting displaced phase and having the property R_w. In addition, this latter portion is considered to be in series with the capillary barrier saturated with the wetting displaced phase and characterized by the property R_B. In Equation 3 it will be noted that for a given set of conditions P_c and R_B are constants, and that all other terms tend to vary with time.

Thus, if it is assumed that when the rate of displacement, Q, becomes less than 10^{-7} cc. per second (i.e. about 0.05 cc. per day) the experimenter will be led to believe that equilibrium has been attained, then it is found that the resistance terms must total 10^4 atm.-second per cc. in order for the error to be 1 per cent (i.e. $E = 0.01$) when a capillary pressure of 0.1 atm. is being measured. However, for such an error to obtain in the event a 1-md. barrier of usual dimensions is being employed, the effective permeability of either the displacing or displaced phase would have to be 0.1 md. or less. This shows that setting 10^{-7} cc. per second as the value of Q which must obtain before externally measured pressures are used for P_c results in errors less than 1 per cent throughout the greater portion of the transition zone.

Equation 2 is of importance in showing that P_c, C or h can be used interchangeably as the dependent variable when describing the capillarity of porous media as a function of saturation. P_c is the parameter commonly chosen because pressure is the measured property, and C is sometimes employed in theoretical studies because it contributes to fuller interpretation of capillary phenomena. On the other hand, since an objective of determining capillary-pressure curves is to indicate the distribution of wetting and nonwetting fluids in transition zones, selection of h as the dependent variable would seem to be the more logical choice.

Limitations and uncertainties inherent in the use of Equation 2 for computation of values of h from values of P_c have been discussed recently by Muskat.[19] In addition, a practical difficulty which is encountered (assuming fluid densities are known accurately) is due to the fact that in some way values of h must be related to values of H, which are the well depths appearing on the well logs* Formally, this relationship is given by:

$$h = H' - H$$

Where

H' = the subsea depth of the oil-water contact, and therefore is an arbitrary constant.

Although in principle a value can always be assigned to H', in practice it can be arrived at only approximately by complete coring, drill-stem testing, cutting analysis, or electric-log analysis. On the other hand, in the event a gas-oil transition zone is being considered in a homogeneous reservoir containing oil, gas, and connate water, H' refers to the subsea depth adjacent to the zone of maximum oil saturation at the highest level where the hypothetical gas-oil interface of zero curvature is presumed to exist. Obviously, it is a complex problem of petroleum geology to devise methods which will accurately relate the beginnings of transition zones to well depths.

In concluding this section it is pertinent to suggest on the basis of the considerations which have been given, that the probability of completely describing fluid distributions in transition zones is remote. This is due both to the theoretical uncertainties regarding the mechanism of transition-zone development in petroleum reservoirs (a geological problem), to the physical limitations which complicate laboratory experimentation (an engineering problem.† In contrast to this concept, it is abundantly indicated that the capillary-pressure experimental approach is well founded in principle, and ultimately technology should advance to the point where reliable information can be obtained. From the practical standpoint, however, it is noted that insofar as one is concerned with reservoir reserve estimates, matters related to transition-zone fluid distributions may be of little importance due to the low interfacial tensions which obtain in reservoirs as a result of reservoir temperatures and the presence of surface-active agents in the oil. Low values of interfacial tension tend to diminish the volumetric extent of the transition zone, as can be seen from Equation 2.

Measurements of Immobile Fluid Saturations

The importance of measuring immobile fluid saturations by the capillary-pressure method has been referred to in the previous discussion.

*The necessity of relating h to H is due to the variation in the areal extent of the reservoir with H, as established by various geological devices in specific instances. This requires a knowledge of the variation of ρ_s with H before the connate-water content of the transition zone can be ascertained.

†A further complication arises from uncertainty regarding the averaging of data obtained on a limited number of core samples from a heterogeneous reservoir.

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The question is simply this: as oil accumulates in the petroleum reservoir what is the factor which effects the retention of some irreducible minimum of the original connate water; and as oil is recovered from the reservoir what is the factor which prevents complete recovery of fluids. In both instances an approximate answer involves the concept that when either the wetting or nonwetting fluids obtain in the interstices at sufficiently low values of saturation, separate fluid elements become disconnected. The "pendular" configuration of the wetting liquid, and the "equilibrium gas saturation" are commonly observed examples of discontinuous fluid elements saturating porous media. This state of discontinuity results in fluid immobility as expressed and manifested by a condition of fluid zero relative permeability, since mass transfer of fluids requires continuous paths for flow.

In attempting to arrive at laboratory values of connate water and nonrecoverable oil applicable for the evaluation of reservoir reserves, productivity, and recovery, one simply employs core samples representative of the reservoir in the appropriate capillary pressure experiment which leads to the attainment of the immobile fluid saturation conditions of interest.* In this method of analysis, the tacit assumption must be made that in the reservoir diffusional or other processes do not appreciably alter the fluid distributions initially there attained in a manner which cannot be simulated by laboratory experiment (c.f. discussion of the diffusional possibilities by Rose and Bruce[20] and the much earlier discussion by Garrison[12]). Thus, as in the case of evaluating fluid distributions in transition zones, theoretical uncertainties somewhat becloud the probabilities of attaining reliable quantitative estimates of immobile fluid saturations by laboratory capillary pressure experimentation.

On the other hand, those interested in practical considerations were willing to accept empirical evidence, there is little reason to hesitate undertaking capillary-pressure experimentation for the measurement of immobile fluid saturations (e.g. values of irreducible connate water), inasmuch as there are many references in the literature establishing empirical justification for such experimentation. For example, McCullough et al.,[17] Thornton and Marshall,[28] and Bruce and Welge[4] show good comparison between the results of the capillary-pressure method of connate-water determination and the results of other independent methods such as connate-water determination from oil-base-mud recov-

*When one of the pore saturants is reduced to a state of immobility in a capillary pressure experiment, it is seen by Equation 3 that the externally measured pressure differential no longer has any significance as an indication of P_c, since the appropriate resistance term in Equation 3 becomes infinite.

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ered cores and determination by the electric-log method. Moreover, estimates of maximum oil recovery have been reported[26 30] which are not unreasonable, although of undetermined quantitative significance.

Measurements of Rock Texture

Much consideration has been devoted in the recent literature to the relationship between capillary phenomena and rock texture.[7 14 21 23 32] The general importance of the considerations which have been developed refer to the possibility of classifying porous media such as petroleum reservoir rock according to texture, and to the possibility of estimating certain of the physical characteristics of porous media through a knowledge of rock texture and measurement of other physical properties. It is noted that the term "rock texture" has a number of connotations[23] which encompass considerations of interspace configurational character and of physicochemical interaction possibilities between interstitial solids and pore saturants. On the other hand, the rock textural constants which will be discussed below refer to specific entities, although in most instances the exact significance of these constants will be obscured by theoretical uncertainties. In what follows the difinition of these constants will be presented together with an indication of the utility of these constants in practical applications.

The Kozeny constant evidently[23] is defined by:

$$t = (\sigma \cos \theta / P_D)^2 (f/k)$$

$$= f/kA^2$$

$$= \left(\lim_{\rho_w \to 1} j \right)^{-2} \qquad (4)$$

Where
- σ = the interfacial tension
- θ = the contact angle
- P_D = the displacement pressure
- f = the permeability
- k = the permeability
- A = the specific surface area (per unit pore volume)
- ρ_w = the wetting liquid fractional saturation
- j = Leverett's[10] capillary pressure function.

Fundamentally, the constant t is defined as the product of a pore shape factor and a pore orientation (tortuosity) factor,[10] and as such is informative with regard to the deviation between the actual permeability which obtains and the ideal permeability of Traxler and Baum[29] which would be predicted from a knowledge of average pore (or grain) sizes.

Because reservoirs and formations have been encountered in practice which are heterogeneous with respect to permeability and porosity characteristics, but which nonetheless are identifiable by uniform values of t,[23] it is regarded that the Kozeny constant has considerable utility as a parameter for classifying the porous media characterizing petroleum reservoirs. The multicore method of capillary-pressure study depends on these considerations,[23] and the wider application of this method will be encouraged if the petroleum geologists find further evidence of textural similarity in given areas resulting from like processes of sand disposition (providing for the initial grain shape and orientation) and from like processes of compaction, cementation and solution channel development (providing for the resultant pore configurational character).

Another rock textural factor of importance appears to be that described by:

$$F = 2\int_0^1 \frac{d\rho_w}{j^2} \qquad (5)$$

as given by Purcell,[21] and as obtained experimentally by graphical integration of capillary pressure data. Calhoun et al.[7] have noted for the porous media they investigated that, apparently:

$$F = 4/t \qquad (5a)$$

This does not appear to be an unique relationship, since it implies that $P_C = P_D/\rho_w^{1/2}$, which Rose and Wyllie[24] noted was too general an expression for the capillary-pressure curve. (This consequence is arrived at by combining Equations 4 and 5.) Therefore, it is believed useful to reexpress Equation 5a in more general form as:

$$tF = \text{const.} \qquad (5b)$$

where tF may be regarded as a new "texture" constant of some importance. The rationale of this concept depends on the fact that a knowledge of t (as related to the displacement pressure), F (as related to the area under the capillary pressure curve), and ρ_{wm} (defined as the "irreducible" connate-water saturation, as related to the vertical asymtope of the capillary pressure curve) would seem to suffice as adequate empirical description of the capillary-pressure curve itself. That is, given the boundary conditions, t, F, and ρ_{wm} for a given system, the nature of the variation of P_C and ρ_w analytically becomes fixed within narrow limits.

In view of the above considerations, ρ_{wm} itself may be regarded as a rock textural constant. In this connection, it is of interest to comment on the general feeling that permeability is inversely related to ρ_{wm} in texturally uniform reservoirs. Numerous curves of the logarithm of permeability versus either the irreducible connate-water saturation or its logarithm are to be found in the literature[4 17 28] and such a relationship, when it holds, can be quite useful in minimizing the amount of capillary-pressure experimentation required to give the reservoir connate-water content. However, consider for example a given packing of spheres (or unconsolidated sand grains). If average sphere (or grain) size is varied, permeability will vary in a proportionate manner, but ρ_{wm} will remain fixed as long as the packing is fixed since ρ_{wm} (like porosity) is a ratio parameter.

In fact, it appears probable that the relationship between permeability and ρ_{wm} so frequently reported in the literature must indicate textural dissimilarities rather than the reverse as commonly claimed. In this respect, one has the further evidence that permeability itself may be a satisfactory rock textural parameter for the classification of reservoir rock in certain areas, as shown originally by the writer in his discussion of Purcell's work[21] where permeability was shown to be proportional to F and t for a number of core samples.

Other parameters could be cited for measuring rock textural character in terms of capillary pressure measurement, such as $(P_c^2/\sigma)(\partial\rho_w/\partial P_c)$, which is an expression for the pore radii distribution coefficient suggested by the Ritter and Drake work,[22] but for the purposes of this paper they are perhaps only of academic interest. In any event, it should be evident that a distinction exists between the texture parameters of the type described above, and those which are commonly used by geologists in the study of sediments. The former measure the structural characteristics of the interspaces, and as such are useful for the description of fluid behavior in consolidated porous media such as reservoir rock. On the other hand, the conventional measurements of grain-size distributions, particle sphericities, and mineralogical composition, while useful for the classification of unconsolidated sediments, apparently have limited application in the solution of practical reservoir engineering problems.

Measurements for Well-Logging Interpretation

In the recent literature a number of papers have appeared bearing on the probabilities of arriving at reliable estimates of connate water from interpretation of well-logging data.[1 2 9 11 31 32] The question of interest seems to center around the selection of the proper value to assign to the resistivity exponent, n, in order to make use of the formulation:

$$\rho_w = I^{-1/n} \qquad (6)$$

Where
- I = the resistivity index as commonly defined and as computed from resistivity log data.

The original contention that "n" necessarily is a universal constant with value close to 2 is now fairly well discredited both by experimental and theoretical evidence. In fact, it appears that the electric-log method of connate-water determination depends entirely on having appropriate values of n for the computation, where such values of n are perhaps best arrived at by core analysis in con-

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junction with the capillary-pressure experiment. This latter is emphasized, inasmuch as the capillary-pressure method provides for interspatial distributions simulating those occurring in the natural reservoir, and Wyllie and Rose have suggested that n can vary with fluid distribution.[2]

Admittedly, the requirement to have cores for the determination of "n" obviates somewhat the necessity and desirability of obtaining connate water values from electric logs, because if the cores are available the capillary-pressure experiment can be performed directly. One then is left only with the possibility of deriving a relationship between n and rock texture by core analysis for typical areas so that subsequently n may be approximated for other similar areas by computation alone, to enable the estimation of connate water from log data according to Equation 6.

Summary

This paper has referred to the importance of capillary phenomena to studies of hydrocarbon accumulation in and recovery from petroleum reservoirs. The capillary-pressure method of core analysis is described as being a laboratory study of reservoir mechanics, where the attempt is made to simulate reservoir conditions (particularly those bearing on capillary phenomena in porous media) in experiments on core samples.

The importance of the discussion which has been required to present these considerations is the emphasis which has been given to the complexities encountered when capillary pressure work is undertaken. Thus, it has been appreciated for some time that values of connate water and nonrecoverable oil, and indications of rock texture, potentially could be derived from capillary-pressure data. Likewise, it has been recognized that electric-log interpretation could be improved by suitable laboratory core studies. But it takes more than the realization of possibilities to accomplish the development of practical techniques of investigation which can be applied on a routine basis.

Therefore this paper has stressed the need to know more about the processes of accumulation and recovery which are to be simulated in the laboratory experiment, and has indicated the need to investigate the statistical problem of averaging laboratory data to reflect on over-all reservoir behavior. Thus it is seen that many of the unsolved aspects of capillary pressure experimentation are matters of direct interest to the petroleum geologists, as well as to petroleum engineers.

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(Continued on page 247)

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Protective equipment should be put on before entering cellars, if there is any danger of gas accumulation. The use of a fresh-air blower mask may be necessary.

Goggles and rubber gloves should be worn when mixing caustic and tannic acid for drilling-mud solutions.

When caustic is mixed for mud treatment, the caustic should always be added to the water; the water should never be added to the caustic. Goggles and rubber gloves should always be worn during this operation.

Caustic-tannic acid solution used in treating rotary mud will severely burn the flesh, but because of dilution and chemical reaction, it is not injurious after it is thoroughly mixed with mud. In case of skin contact, workers should wash immediately and freely with fresh water.

Empty caustic cans should first be punctured so they will not hold water and should then be disposed of permanently.

Goggles should be worn by all members of the crew and all other persons working nearby while sodium silicate is being mixed by means of the conventional mud hopper.

In handling sacked sodium silicate members of the crew should keep their sleeves rolled down, with cuffs over the gauntlets of their gloves.

When silicate mud is used, all members of the crew should wear goggles while making trip with drill pipe, while making a connection, or while running wire line for any purpose.

While repairing silicate mud pumps men should wear goggles.

Respirators and goggles should be used, when a well is cemented, by the men at the cutting table and those working in the immediate vicinity. Provision should be made to keep respirators clean and sanitary when they are not in use.

Elsewhere in this issue is a step-by-step account of deep-rotary-drilling operations. This story emphasizes, perhaps more than anything else, the great amount of teamwork that it takes to carry out today's "big league" drilling. The driller and his crew have the responsibility of making hole efficiently and safely. With deeper wells and heavier rigs this has become a "big league" responsibility. It takes skill and know-how to run the rig and above all it takes plenty of teamwork to do it safely.

Possibly the greatest asset of a smoothly functioning drilling crew is that its members have learned to work together safely. Safety on the drilling rig means attention to a great many details. The safety practices given here are new recommendations issued by the Office of Safety Supervisor, Texas Bureau of Labor Statistics, Austin; additional material is from A.A.O.D.C.

Use of gauntlet gloves should be discouraged except in welding operations or electrical work.

Wearing of finger rings should be discouraged when on the job, especially when working around machinery.

Loose or ragged clothing should never be worn by employes working around machinery.

Use of goggles.—To insure maximum protection and comfort, goggles should be adjusted properly to each individual's face. Goggles might fog under certain conditions. Glycerin soap smeared on the lenses and then wiped off will help to prevent fogging.

Workers should wear goggles when: (1) Chipping or cutting stone, brick, or concrete or breaking cast iron; (2) chipping cast iron, steel, brass, babbitt, or any other metal or material that may involve flying-chip hazard; (3) handling materials in powdered or semipowdered form where a dust hazard exists or where hazardous chemicals are handled; (4) cutting wire line; (5) sledging rock bits or core heads to loosen or tighten them; (6) driving or removing keys in tongs; (7) painting hot boilers; (8) hammering fittings and connections; (9) cleaning tubes in boilers, economizers, flues, and stacks; (10) driving and holding rivets; (11) chipping and caulking seams, rivets, and pipe-line leaks; (12) grinding on abrasive wheels, even when glass guards are provided; (13) helpers for acetylene welders or electric welders should use proper shade lenses; (14) employes should exercise extreme caution when working near electric welding arc as it will severely burn the eyes and exposed skin; (15) when on any other operations where there may be danger of flying particles striking or entering the eyes or where judgment deems necessary.

HAND TOOLS

Tools should be inspected regularly. Any tool not in good condition should be repaired or discarded. Chisels, punches, and cutter heads in poor condition should be dressed down and burrs removed. End wrenches

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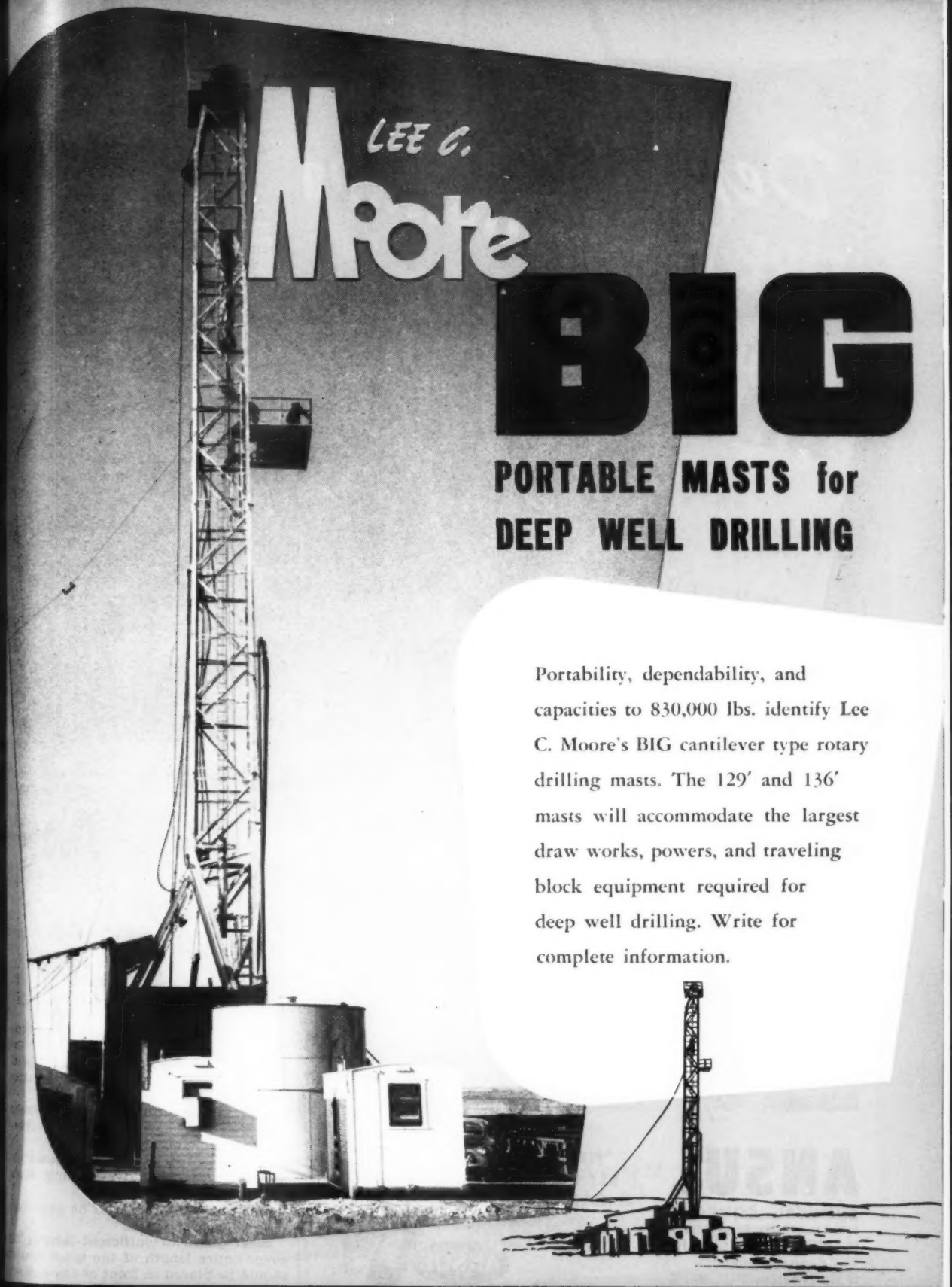

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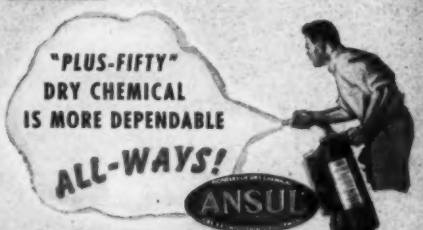

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with spread jaws should be discarded.

Men should not work on the floor while work is in progress overhead unless their help is necessary for the overhead job.

Tools should be kept neatly on the tool bench so they may be easily found when needed. They should not be left lying on the derrick floor, walk, stair, or other places where they would present a tripping hazard.

Adjustable pipe wrenches and crescent wrenches should be adjusted to take a full but snug grip on the pipe or nut, and the pull should be made toward the open jaws of the wrench. This tends to tighten the grip and does not put undue strain upon the wrench.

When a wire line is to be cut, the line should be wrapped at two separate places on each side of the point where the cut is to be made. An approved wire-rope cutter should be used. Goggles should be worn while cutting wire rope with either an approved cutter or with cold cut and sledge.

EQUIPMENT GUARDS

All draw works, chains, and sprockets should be equipped with adequate guards.

Pinion shaft and drive pinion on every chain-drive rotary should be guarded with metal shields to prevent worker's foot from becoming entangled with the moving parts.

Eyebolts or handles should be installed near the center of gravity on all heavy machinery guards. This will eliminate the hazard of wrapping chains or lines around guards.

All clutch-shifter dogs and fingers on all types of engine and motor friction clutches should be guarded.

All inspection plates or windows on guards should be closed during normal operations.

All rotary tables should be guarded with an apron guard.

Steel guard of sufficient length to cover entire length of the hoist drum should be placed in front of the drum.

All guards should be strong enough to withstand the shock of breaking chains and should be so installed that

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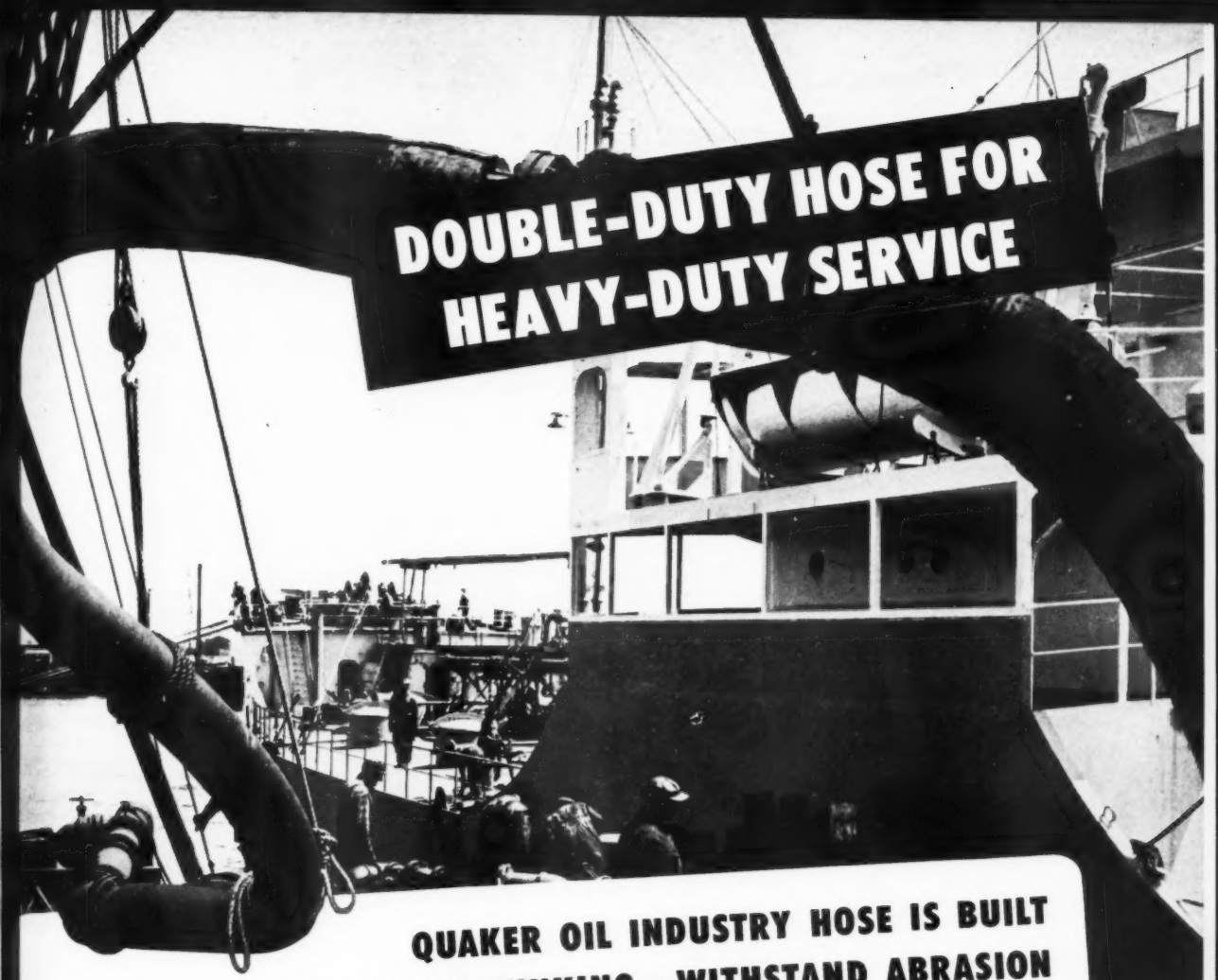

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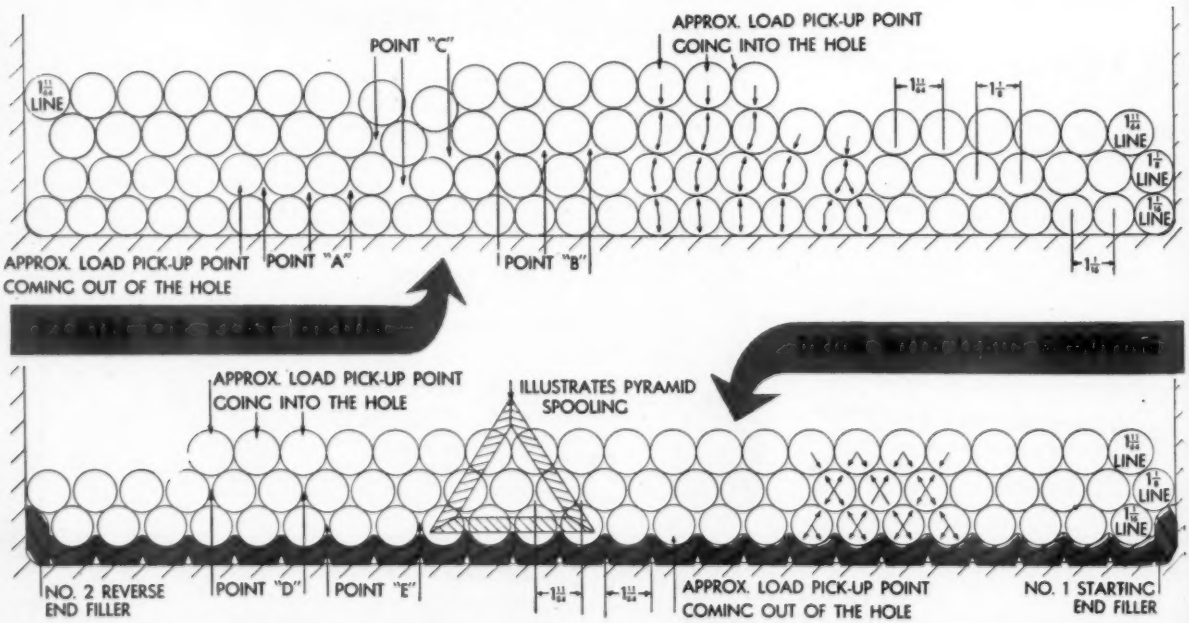
The LeBus Wire Line Grooving and Spooling System has been engineered and developed to meet an urgent requirement to cut the costs and improve the performance of wire line. Pinching, Squeezing, Crowding and Mis-shaping of Wire Line is indicated by crooked arrows on *the Cross-Sectional drawing of the Flat or Plain drum below.* Flat Drum spooling is wasteful to Wire Line and hazardous to the Drilling Crew. These Wire Line Troubles are remedied when your Drum is grooved with LeBus Grooving and End Fillers *as shown below on the cross sectional drawing of a grooved drum.* Even a tapered or distorted line spools evenly and safely on a grooved drum. The l... line up as indicated by crossed arrows. T... wraps "Pyramid" as shown with large ... angle. This controlled contact and ... loads mean longer life and safer dri... operation. The photograph and inset to t... left is a drawworks drum with the Le... Wire Line Grooving and Spooling Syst... installed and with the first layer of l... wrapped to the preferred pick-up po... when coming out of the hole to change b... It pays to look into LeBus Wire Line Groo... ing and Spooling — Many of the Larg... Drilling Contractors have installed this s... tem. Why? It has saved them money.

Theoretical Illustration of the Spooling of a Tapared or Stretched 1⅛" Wire Line. A.P.I. Tolerance 1⅛ + 3/64 or — 0 Diameter

This print also illustrates the comparable difference in the amount of line required on a plain drum and a grooved drum, when the pipe has been picked up to the required height for making connections.



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workmen cannot come in contact with moving parts. Guards on chains near working positions should be flanged with steel plates so a breaking chain cannot hit workmen or foul levers or throttle.

DERRICK FLOORS, LADDERS

Derrick floors more than 2 ft. above ground level should have steps equipped with hangers and these steps should be located at two or more places. Steps should be securely fastened to the derrick floor.

Standard handrails should be provided when four or more steps are required.

All steps around the rig should have a suitable nonskid surface.

Derrick floors should be as even as possible to eliminate stumbling hazards. The tops should be of rough, unfinished lumber. Broken boards should be replaced.

Opening for the rotary should be kept closed when the rotary is not in place.

All passageways, exits, ladder approaches, and working floor space should be kept clear, in good repair, and free from nails and other obstructions. Tools and other material should not be kept on floors or walkways.

All space between the drum and the rotary should be floored to the level of the rotary. Flooring should conform to the curve of the rotary table. The space over the shaft bearing between the drive-shaft chain sprocket and the table should also be adequately covered.

Derrick ladders should reach from the derrick floor to the top of the gin pole, and unless they are the enclosed type, should run in a straight line from the floor to the crown. They should not extend below the derrick floor sill.

All space around the casing racks should have no obstructions which might cause employes to stumble or fall during loading and unloading operations.

Rathole casing should extend at least 18 in. above the working floor level. The mouse hole should be covered at all times when not in use.

CROWN AND TRAVELING BLOCK

Crown block should be securely fastened to the water table.

Two-line stringup at least, should be used when crown blocks are lowered or landed. When handled as a single unit, the lines should be strung through the stringup block attached to the gin pole and through the center sheave of the crown block. The lines should be dead-ended at the gin-pole crosspiece.

When lowering or raising crown blocks or other equipment after wells are completed, workers should take

Use Tools Safely!

Due to so many accidents being caused from mushroomed chisels and punches, it is recommended that these be repaired as follows:

1. Grind the heads of the chisels and punches so that they are beveled at least ⅛-in., toward the center.
2. Braze ¼-in. of bronze on the head of the tool. This will prevent it from mushrooming and the bronze will not chip off when hit with a hammer or sledge.

A Few Simple Rules

1. Never use a hard-faced hammer on a highly tempered tool, such as a drill, file, die, jig, etc. Chips may fly.
2. Use only wrenches that are the right size for the particular job.
3. Keep chisels, knives, axes, and all such cutting tools sharp.
4. Don't use a tool with a broken or splintered handle or a loose part.
5. Wear goggles when using tools that may produce flying pieces.

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Check these big M-25 features: easy field installation . . . maximum effectiveness . . . reasonable cost. The new S-I-W M-25 scraper is a bear for wear . . . a profit-saving paraffin control tool!

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special precautions to guard the christmas tree.

All traveling blocks should be strung and unstrung on the derrick floor.

Suitable stringup chain or a snake should be provided at each rig and should be used only for stringing and unstringing lines.

Effective means should be employed for holding all traveling blocks securely while they are being strung and unstrung.

Every traveling block should be equipped with safety housing that has no square bolt heads or other abrupt projections. The housing should be arranged with holes or slots for cables to pass through before reaching the sheaves, so that the workmen's hands and fingers may not be drawn in between sheaves and cables.

Traveling-block guard should be installed with through bolts at top and bottom, and each finger on the guard should have holes for these bolts.

CHAIN HOISTS AND SNATCH BLOCKS

Chain hoists and snatch blocks should not be fastened to girts unless girt is sufficiently reinforced so as not to weaken the derrick.

When a chain hoist is used for setting up a rig, it should be hung from the water table.

Snatch-block hook should be closed or bridled into the eye of the eyebolt attached to the tong sill.

DERRICK BOARDS, PLATFORMS

Derrick boards should be landed by the catline and held by it as long as all or any portion of a board is not securely fastened to the derrick.

Thribble or fourble board should cover the space from the working edge to the legs and girt of the derrick, and should be fastened to the derrick by U-bolts or other adequate means.

Individual boards of all working platforms in the derrick should be held together by at least two metal strips at least ½ in. by 4 in., one on each end of the boards. The strips should be bolted, not nailed or screwed, to each individual board.

Runaround platform should be installed on all permanent working platforms, including the water table.

Temporary working platforms such as stabbing or swabbing boards should consist of two boards at least 3 by 12 in., fastened together by bolted iron straps. These platforms should be fastened at each end to girts with U-bolts or cable.

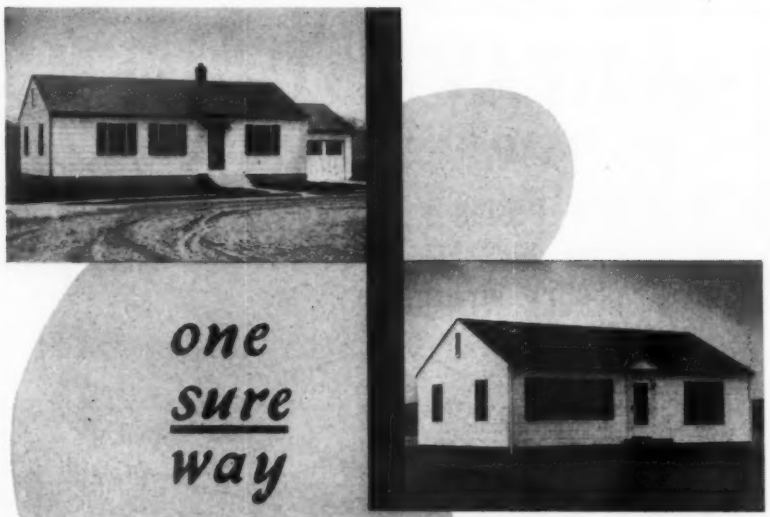
IT WAS AN ACCIDENT—YES, THEY SELL SAFETY SHOES—NO, I DIDN'T BUY A PAIR—YES, I WISH I HAD—NO, THEY AREN'T EXPENSIVE—YES, IT HURTS—NOW BEAT IT!

LIFE LINES

Each drilling derrick should be equipped with a life line to be used as an emergency exit for the derrick man. This line should be of ½-in., 6 by 7, galvanized marine cable, and should extend from above the working platform to a deadman. It should be tightened to a tension of approximately 800 lb., or so that a man hanging on the line will touch the ground from 20 to 25 ft. from the anchor. The length of lines for derricks 94, 122, 136, and 165 ft. high are 196, 285, 325, and 370 ft., respectively. A standard safety buggy should be placed on each line and secured in such a manner that it may be readily loosened should an emergency arise.

If tubing is run in doubles, a safety slide line should be installed at the tubing board platform.

Men should not ride the safety buggy from the derrick except in emergency. The buggy should be tried



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out on the ground so the operator is sure it is in good working order.

No workman should at any time ride the traveling block or hook, or slide down pipe or catline, when coming out of the derrick.

Even if a minor injury is received by a worker in the derrick, the catline should be attached to his derrick belt and kept fast until he has climbed down the ladder to the derrick floor. If a man is unconscious, he should be lowered to the floor by the catline.

Standard derrick belt should be worn by every worker in the derrick above the derrick floor except while making inspections. All derrick belts should be carefully inspected regularly and replaced when necessary.

Tail line on derrick belts should be carefully inspected regularly, and damaged lines should be replaced.

Tail lines on derrick belts should be of a minimum of 1-in. manila rope or of approved regulation wire line and should be securely tied directly overhead as nearly as possible to the center of the derrick. Excess slack should not be allowed in the tail lines.

Substantial hand line should be installed above stabbing board or swabbing board.

Life lines and derrick slides on all rigs should be installed before drilling out from under surface casing.

Windbreakers should be provided with openings so that derrick man will have immediate access to his safety slide.

CATHEADING PRACTICES

All catheads should be equipped with safety divider for separating the first wrap of catline or spinning line.

Catlines should be used only by properly instructed workmen and then some responsible person should be at the throttle valve to stop the line shaft should the catline become entangled.

Cathead should never be turned any faster than is necessary.

Frazzled catline should never be put on the cathead until the frazzles have been removed. A spliced catline should never be used. If catline is badly worn, it should be replaced.

When catheading, workers should carry but one wrap on the cathead

Working With Propane-Butane

Building of fires underneath storage tanks to increase the pressure is not only extremely dangerous but is absolutely unnecessary. If increased pressure is needed, then the mixture of butane-propane should be changed so that no artificial means, such as building a fire, is necessary to increase the pressure. The tank is constructed to stand certain pressure and as an added safety factor it has a pop-off or safety valve. When the pressure inside the tank becomes greater than that which was provided for in the construction of the tank, then the safety valve opens and allows the vapor to escape. When such pressure is caused by a fire under the tank, the escaping gas being 2½ times heavier than air, regardless of whether it is in the form of a vapor or liquid, settles to the ground and of course will be ignited by the fire. Bad fires and personal injuries have resulted from this unsafe practice.

The use of a rubber hose for connections instead of using copper tubing or solid pipe is just another accident waiting to happen. If the setup is such that flexibility is needed in the connecting line, then copper tubing with proper fittings should be used. Both copper tubing and solid pipe are available. There is no excuse for the use of other than proper connections and fittings.

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until the catline or other rope is in tension; then add only sufficient wraps to meet load requirement.

All slack should be pulled out of of the catline before any wraps are put on the cathead.

Tension should always be kept on a rope used on a cathead so that loose rounds will not be thrown around the cathead and entangle the operator.

Lineshaft should be turning slowly as the first wraps are placed on the cathead.

No one should stand on the coil of rope under the cathead when the line is being drawn in or let out.

Catline should be guided so it will not rub on derrick girts or any other sharp edge.

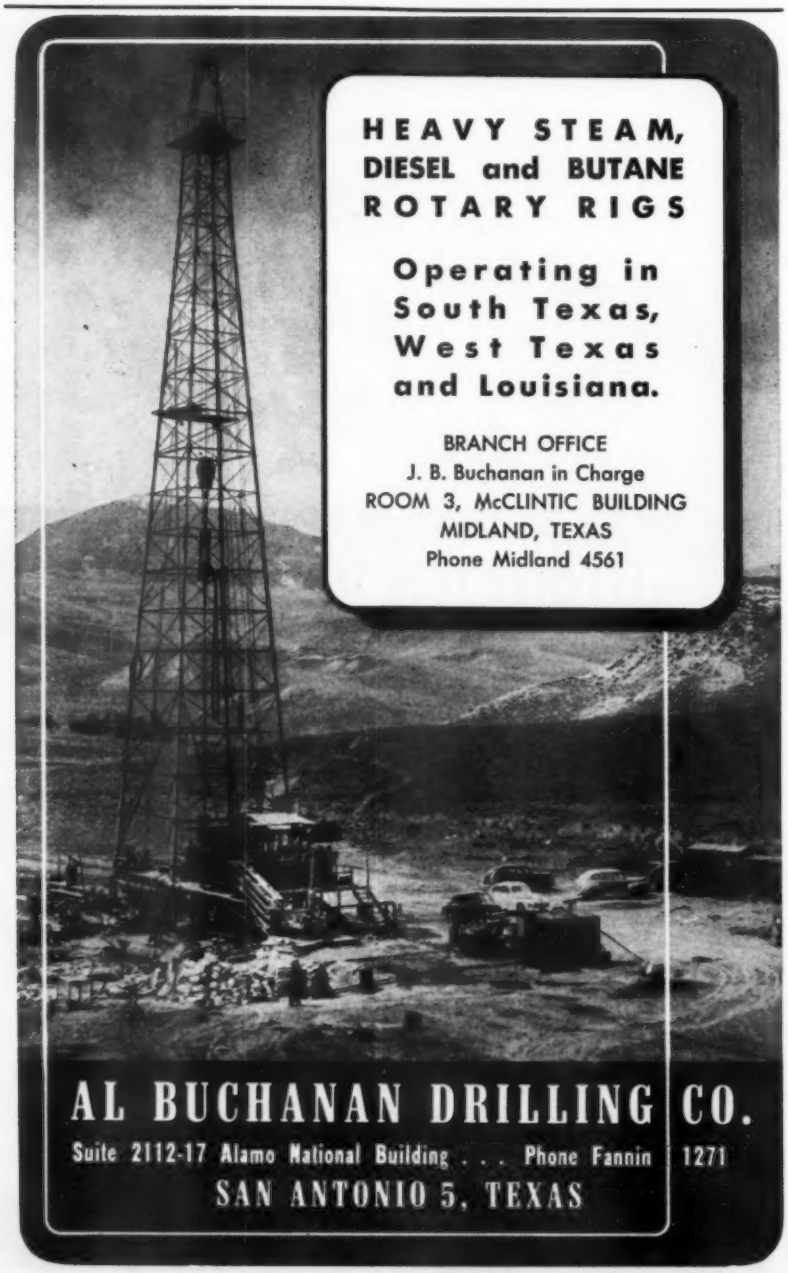
When raising any boards with a line, workmen should make certain that boards are securely fastened. A nail driven in each board will help to prevent boards from slipping.

When a catline fouls, the operator should not try to untangle the line. He should notify the man at the throttle to stop the lineshaft.

BRAKES AND CLUTCHES

Driller should be constantly alert to avoid injury from the kicking of a brake lever.

Driller should never leave the brake without tying it down.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Stop Accidents at the Rotary Table

A great many of the injuries in the drilling industry occur in the immediate neighborhood of the rotary table. The worker's hands are pinched by the tongs; his fingers are mashed between the tongs and the drill pipe; he is struck on the hands, wrist, lower arms, or face by the spinning chain or tong line. All these are examples of the types of injuries that are happening.

Use of the drilling-industry color coding can help the worker see the tongs better even though he may not be looking directly at them. Longer spinning chains in some cases, or taking enough wraps around the pipe to make certain that it will run snug before the chain is run off, also reduces the hazards. The driller must work with his crew so as not to throw too much whip in the tong line while men are still close to it. All these suggestions will help reduce the number of accidents and injuries to men working around the rotary table.

Driller should never engage the rotary clutch without watching the rotary.

Rotary clutch mechanism should be equipped with positive-acting, safety lock to prevent clutch from being engaged unintentionally.

All block clutches should have springs on the yokes so they will not become engaged while a trip is being made.

Clutch on a gas or oil engine should not be adjusted while the engine is running.

HANDLING PIPE, TUBING, CASING

Workmen should never place hands, feet, or any part of body under a joint of pipe when it is off the floor, as there is always danger that the pipe will drop and injure the workman. Worker should never place his foot on the rotary when it is in motion.

When racking pipe in the derrick, if the stand of pipe is not close enough, the driller should pick up the stand and allow the pipe racker to reset it. This will eliminate the hazard which results when the pipe racker drives the stand in place with a sledge hammer.

Derrick man should never be out on hayrake fingers when the traveling block and hook are passing.

Three or more stands of pipe should be placed on the pipe rack when the drill stem is laid down, as protection for the pipe racker against the breakout tong handle.

DRILLING SAFETY

Driller or any other operator should not leave the controls while the hoisting drum is in motion.

When a rotary is double-decked, a hoisting drum should be used when practicable, to pick up inside the rotary.

All lift plugs for flush-joint pipe should be tightly hammered to prevent their backing out.

Use breakout block if possible for making up and breaking out all bits, to eliminate the hazard of using sledge hammers in making or breaking bit joints.

When any unusual strain is taken on the tongs, all workmen except the person required to operate the draw works should stand well in the clear.

Tong jaws of proper size should be used on each size of pipe.

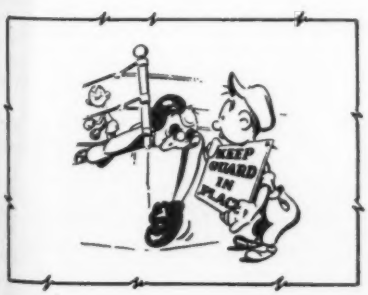
When unlatching elevators, the operator should stand on the side of the pipe where the elevators are latched.

When going in the hole, the pipe should be stopped with the brake before the rotary helpers put the slips in the rotary. The slips should be grasped with the palm of the hand toward the drill pipe. As the driller slowly lowers the pipe, the slips will settle into place evenly and will grip the pipe securely. If the slips are held with the back of the hand toward the pipe, it may be difficult to let go of the slip handles, and the hands may become seriously injured if they are caught as the slips are drawn into place by the weight of the pipe. To facilitate removal of the slips, their tapered side should be greased. Slip-handle hinges should be kept well lubricated, so that they will work freely. Frozen hinges frequently cause injury to hand and fingers. Slips should not be kicked into place. Such attempts have resulted in toes getting caught and pinched off.

When measuring pipe in or out of the hole, the derrick man should not climb on the pipe. A satisfactory method is for the derrick man to be equipped with a rod on which the tape can be hooked.

When pulling stuck pipe or when making any unusually hard pull, only the driller and one man stationed by the engine should be on the derrick floor.

Derrick floor and steps should be washed after each trip or at any other time they are muddy.



All drilling hooks should be kept closed while round trips are being made.

Two-inch tubing, unless supported at the approximate midpoint by an additional derrick board, intermediate rack or sway board, should not be racked in the derrick in lengths of more than 65 ft. It is recommended that such intermediate racks be made of steel, and they should be securely fastened to the derrick with U-bolts.

No more men than are necessary to perform the operations should be on the derrick floor while swabbing or running coring or other types of line.

Derrick floor should be cleaned and placed in order before casing or tubing is run.

Lift lines should be of ⅝-in. cable for pipe 10¾-in., in diameter or smaller. For all other pipe up to and including 13⅜-in., they should be of ¾-in. cable. A lift line should never be used on pipe larger than 13⅜-in. diameter.

Protectors removed from casing or tubing should be kept in containers out of the way, and should be removed from the derrick floor when the casing or tubing job is completed.

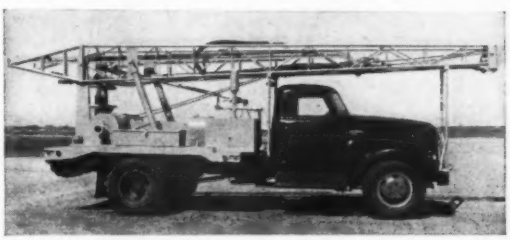
Pipe should be set on slips, no pipe should be racked in derricks, and all possible weight should be removed

For Drilling Holes You Can't Beat
Franks MACHINE CO. MODEL KC DRILL

The new heavy duty FRANKS KC-45H Drill is designed for heavy duty shot hole work where the drilling is rough, and is equally efficient on core drilling. To 1500 feet FRANKS KC-45H is tops!

Drilling is controlled by a variable-speed 10-foot feeding device operated hydraulically. This outstanding feature combines hydraulic advantages with speed and extra ruggedness of a chain pull-down machine.

Here is the new improved KC-45H



- Three speed transmission for rotary.
- Larger rotary clutch.
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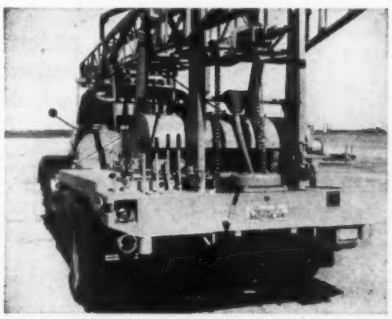
- Heavier hydraulic feeding device
- Later design hoist.
- Improved water swivel.

All controls are so designed and arranged to provide maximum convenience and ease of operation. A hinged breakout tong mounted on the rig provides greater speed and safety in breaking out.

Drive attachment can be furnished for drilling 3" or 4" casing, important where boulders are encountered. Chain transmission drive unit encloses all chains, sprockets and clutches in an oil bath. 2" opening through water swivel and piping reduces pump pressures and expedites removal of cuttings from hole.



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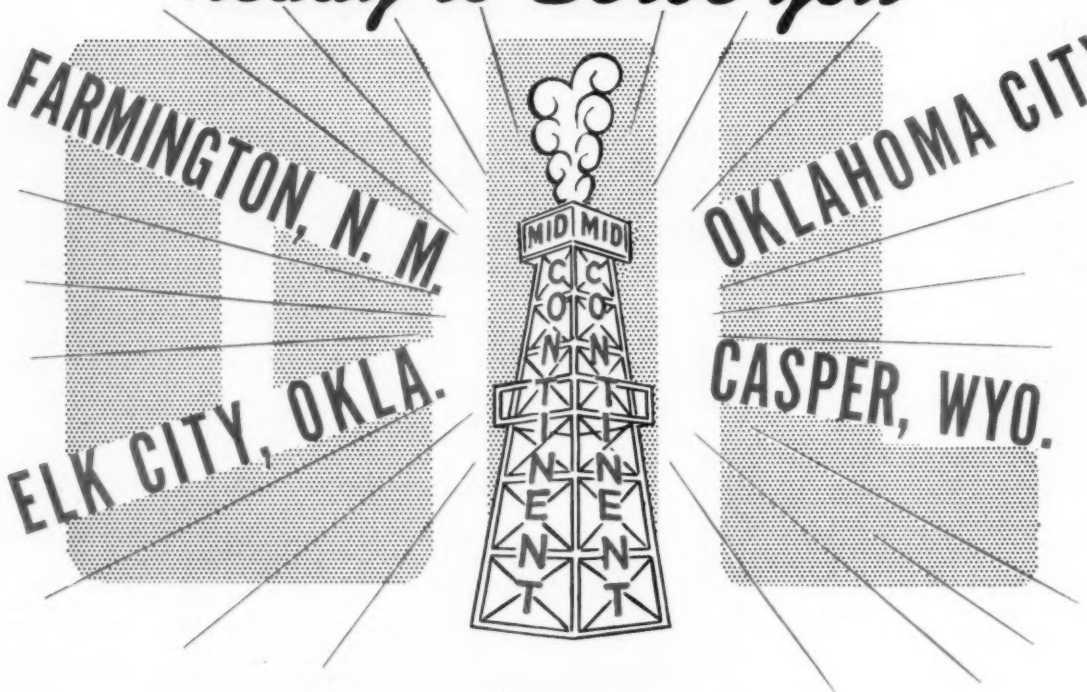

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from the derrick before derrick members are removed.

Hands should be kept out of open ends of pipe when picking it up.

All pipe should be securely blocked with a minimum of 1-in. blocks nailed to the sill or tier strip. Approved scotch blocks are acceptable.

A suitable snub line should be tied to one corner of the derrick, extending across the "V" and snubbed to the other corner of the derrick so a man can stand in the clear while snubbing pipe from the walk.

WORKING WITH STEAM

When steam is turned into a cold line, the valve should be opened very slowly to prevent water hammer. As the line heats and expands, the valve can be gradually opened. Accumulated water should be drained from lines.

Steam should be carefully admitted into a hose and the nozzle should be attached or held securely while steam is turned on. The person operating the steam hose should be well braced and should use care in handling this hose, being particularly careful not to point it in the general direction of anyone in the vicinity.

Work should not be performed on engines, motors, draw works, hoists, chains, tables, or other motive equipment unless the steam valve back of the throttle valve on the steam engine is closed, the steam is bled from the cylinder, and the cylinder cocks or bleeders are open. If an electric motor is used, the main electric switch should be opened. If a gas engine is used, ignition should be disconnected. Care should be taken to remove spark-plug wire sufficient distance from spark plug; it is recommended that the spark plug itself be removed from the cylinder after disconnecting the wiring.

Drilling boilers should be placed at least 150 ft. from the edge of the derrick, and on the prevailing windward side. Neither the front end nor the back end of the boiler should point toward the derrick. All drilling boilers should be connected, operated, and maintained in accordance with the state boiler law or other regulations.

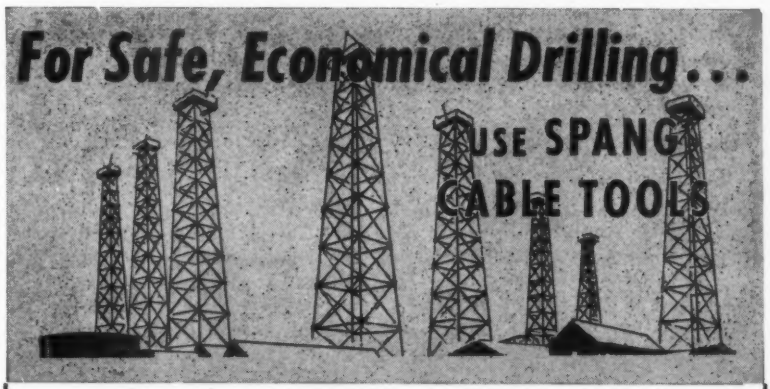
Only wire-wrapped hose should be used for steam at drilling wells, and

The Drilling Contractor And Accident Prevention

R. W. (Bob) Wire, president of Loffland Bros. Co., says this:

"It has been stated from accurate analysis that 90 per cent of all accidents are controllable; they are the result of improper performance of workers, or the existence of known mechanical hazards, both of which can be controlled. In the light of such a situation isn't it mandatory that we do all we possibly can to save our fellow workmen from loss of life or serious injury, as well as to reduce the tremendous cost which we pay as a penalty for not doing something about it? A disregard of known right working methods, a violation of established safety rules, a disregard of unguarded machinery, a toleration of unsafe conditions, are bound to result in accidents, injuries, and economic loss.

"Therefore, it is the responsibility of every supervisor from the tool pusher to the chairman of the board of directors, or owner, to become aware of this problem and to do something about it. It isn't enough to appoint a safety engineer and let him wander around the field doing what he personally can to teach safe practices to the workmen. Rather he must have the complete backing of the field superintendents as well as the officers of company. He must have the authority to challenge everyone who approaches the line between danger and safety."



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Spang Drilling and Fishing Jars, each made from a single piece of highest-quality alloy steel by drop and hammer forging and then heat-treated for utmost serviceability and safety, have proved their practical advantages for years, in comparison with jars of the welded type.

Spang Weldless Jars are known throughout the world, and are preferred wherever cable-tool drilling is done. While they cost more to buy, they are more economical to use because of lower footage cost and less time lost in fishing and replacement. Standard stroke lengths, diameters, and joint sizes are readily available at field stores.

The HIGHER STANDARD

SPANG CABLE TOOLS made by SPANG & CO. BUTLER, PA.

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OIL WELLS • GAS WELLS • ARTESIAN WELLS
SHOT BLAST HOLES • PROSPECT DRILLING

SPECIFY SPANG—FOR SALE BY DEALERS EVERYWHERE

this hose should be properly grounded to avoid any static charge. This hose should be grounded by one end of the wire attached securely to the nozzle and the other end to the steam line.

Water and steam lines should never be converged into one discharge.

BUTANE INSTALLATIONS

To facilitate the quick detection of dangerous leaks in the butane or propane-butane storage and piping system, all L.P. gas should be odorized with an acceptable malodorant. Every load of L.P. gas delivered should be checked to determine whether it has been adequately odorized.

If butane storage tanks must be recharged during darkness, precaution should be taken that the light used is explosion-proof. A floodlight directed on the tank from the rig should be adequate.

L.P. gas tanks for a drilling rig should be 150 ft. or more from the rig. They should be on as high ground as possible, on the leeward side of the rig (with respect to the prevailing wind). They should be parallel to, not pointing toward, the rig.

Each butane rig should have at least one fire extinguisher approved for use on pressure gas fires.

All piping and fittings on butane rigs should have a safe working pressure of at least 125 psi. Steel piping for the mains and heavy copper tubing for the small connections are recommended. Cast-iron fittings should be prohibited. The piping system should be tested and free of leaks at one and one-half times the pressure to which it may be subjected.

Piping for butane should be run as directly as possible, without sags. Provision should be made for expansion, contraction, jarring, vibration, and settling of the container.

Piping from aboveground butane storage to the rig should be buried or in some other way protected from mechanical injury or freezing.

The butane-storage tank should have a spring-loaded relief valve. No unauthorized person should tamper with this relief-valve setting.

Any unloading practices of the L.P. gas distributor which appear unsafe should be reported to the driller so they can be investigated.

EQUIPMENT INSPECTION

All-metal tool houses should be electrically grounded.

All electric rigs should be properly grounded and guarded.

Direct connections from carburetors to gasoline drums should be used for gasoline motors. A hose from the carburetor dropped in an open can or drum bung-hole should never be used.

Pump end of all drilling hose should be securely fastened to the derrick by a cable or chain clamped to the hose and the derrick leg. The swivel end of the hose should be secured by a chain or cable clamped to the hose, and the other end should be fastened to the body of the swivel. The cable or chain should not be fastened to the swivel gooseneck, as the gooseneck may break. The safety cable should be not less than ⅝ in. in diameter and the chain not less than ½ in.

Standpipe clamp bolts should be equipped with cotter pins, lock nuts or lock washers to prevent loosening of nuts from vibration.

If rotary hose is connected to washdown pipe, it should have a safety line clamped from the hose to the elevator bail.

A continuous steel cable should be clamped to each section of all steel drilling hose to prevent any section

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SAFE The enclosed cutting blade locked in the body of the cutter assures perfect safety.
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from whipping in case of a blowout. This cable should be anchored to the derrick leg and swivel.

All lines which may be subjected to high pressure or a high rate of flow should be anchored.

Operating valve on a slush pit or other jet lines should be far enough from the jet so that if the steam line blows loose from the jet, it will not hurt the operator.

Weight indicator should be connected before a well is started.

Pressure-relief valve of an approved type should be part of the discharge manifold on every power-driven pump. It should be placed ahead of any valve on the line. Relief valves should be turned so that discharge will be directed away from workers and equipment. When discharge extensions are necessary, they should be properly anchored.

Shear-pin-type relief valves should have suitable guards to prevent sections of sheared pins from flying when the valves relieve.

Chain-tong rack should be anchored so it will be steady and cannot be pulled over.

Weight-indicator diaphragm should be tied back to the derrick so that it will not be thrown across the floor when a sudden shock is placed on the drilling line.

Weight box or any weight suspended on cable should not be tied to a girt of the derrick unless the girt is properly reinforced.

Breakout and backup tongs should have safety lines to confine their swinging to definite areas.

Counterbalances for tongs should be suspended under the derrick floor, if possible.

On all counterbalances suspended above the derrick floor, one end of a safety cable should be attached to the balance and the other end tied to the derrick leg in such a manner that, should the supporting cable break, the balance would be held in the corner of the derrick.

Additional weights on the counterbalance should be securely fastened to it.

Manila rope used for a jerk line on tongs should be at least 1 in. in diameter.

Wire-line coring-reel units should not be used in setting up or tearing down rigs.

Core-barrel overshots, while not in use, should be securely fastened back, preferably to the guards on the coring units.

Protruding keys or key seats on all catheads should be covered by thimble-type guards.

Badly worn cathead, grooved, or otherwise damaged, should be replaced or repaired.

Every drill-pipe hook or casing hook should be guarded to prevent the elevator or swivel bails from becoming

Case History: Accident in Caustic Mixing

In the process of mixing drilling mud, a rotary helper filled two containers about three-fourths full with water at line temperature, opened a 100-lb. can of caustic, and slowly dumped one-half of it into the first drum. He poured the remainder of the caustic rapidly into the second container. There was an immediate explosion from the second drum which threw water and caustic into the air and onto employe mixing the mud and a rotary derrick man observing the operation.

Direct cause: Taking unnecessary chances (dumped large amount of caustic at one time into warm water).

Basic cause: Lack of training and supervision.

Recommendations: Before mixing chemicals, determine that chemical barrels are empty and clean. Fill barrels approximately two-thirds full of water and add caustic **slowly** in small amounts. Proper protective equipment should be worn during this operation.

CLAMP DOWN ON LEAKS

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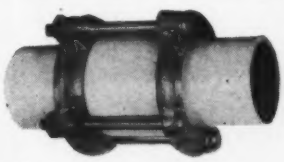


COLLAR CLAMP

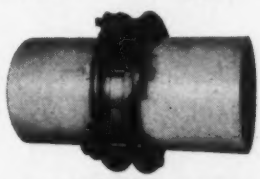
Styles 4 and 41, for repairing and preventing leaks through threads of screw collars.

BAND CLAMP

Style 77B, for repairing small leaks and holes in the run of pipe.

SPLIT REPAIR CLAMP

Style 79B, for repairing pitholes and longitudinal splits in pipe.



POROUS-WELD CLAMP

Style 55, for repairing circumferential weld leaks.

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unintentionally disengaged from the hook.

All elevator handles should be equipped with ears to prevent workmen's hands from being mashed between the elevator and the bails.

No field welding should be permitted on tongs, elevators, bails, or other heat-treated equipment.

Makeup posts should be provided with brackets at the bottom to prevent turning. Makeup and backup posts, if used, should fit snugly in the rotary table.

Driller should inspect the drive bushing when going on tour and see

that the retaining ring is properly screwed on and securely fastened to the body of the bushing.

Day derrick man should inspect and report to the driller the condition of the derrick above the first girt, noting loose nuts, slack guy wires, and the condition of the safety slide line in particular. The morning and evening-tour derrick men should note and report changes in condition of the derrick or hazards that have developed during their tours.

Derricks showing any signs of weakness should be repaired, preferably by competent rig builders.

Day crew on steel derricks should inspect all nuts at least once each 15 days to be sure they are tight.

Steel girts and braces should be inspected and all crooked pieces replaced with straight ones.

Derricks showing any signs of weakness should be repaired, preferably by competent rig builders.

Derrick wiring should not be strung on girts.

All crown-shaft journals should be provided with bearing caps or straps to prevent the shaft from jumping out of journals.

Exhaust lines for all gas or oil engines should extend outside the buildings.

Field gas and oil lines should be broken out away from the source of supply or disconnected from the source of supply to reduce the danger of fire or asphyxiation if the control valve should leak.

Gas systems should be connected to gas regulators.

Ladders on fuel or water tanks should be properly constructed and securely anchored. Walkways and stairways are preferable.

First-aid kits should be furnished and kept completely filled. Snakebite kits, where required, should be available at all times.

Gasoline should be stored in iron barrels when available, or Underwriters' approved containers. Extreme precautions should be taken when handling. All bungs and plugs should be replaced in barrels.

Opening for the rotary table should be closed when the rotary is not in place.

Vaporproof cover globes on extension lights used on derrick floors should be kept in place.

All vapor covers and floodlight lenses and globes should be kept clean to allow a maximum of light.

Derrick floodlights and hanger should be equipped with safety chains fastened to girts.

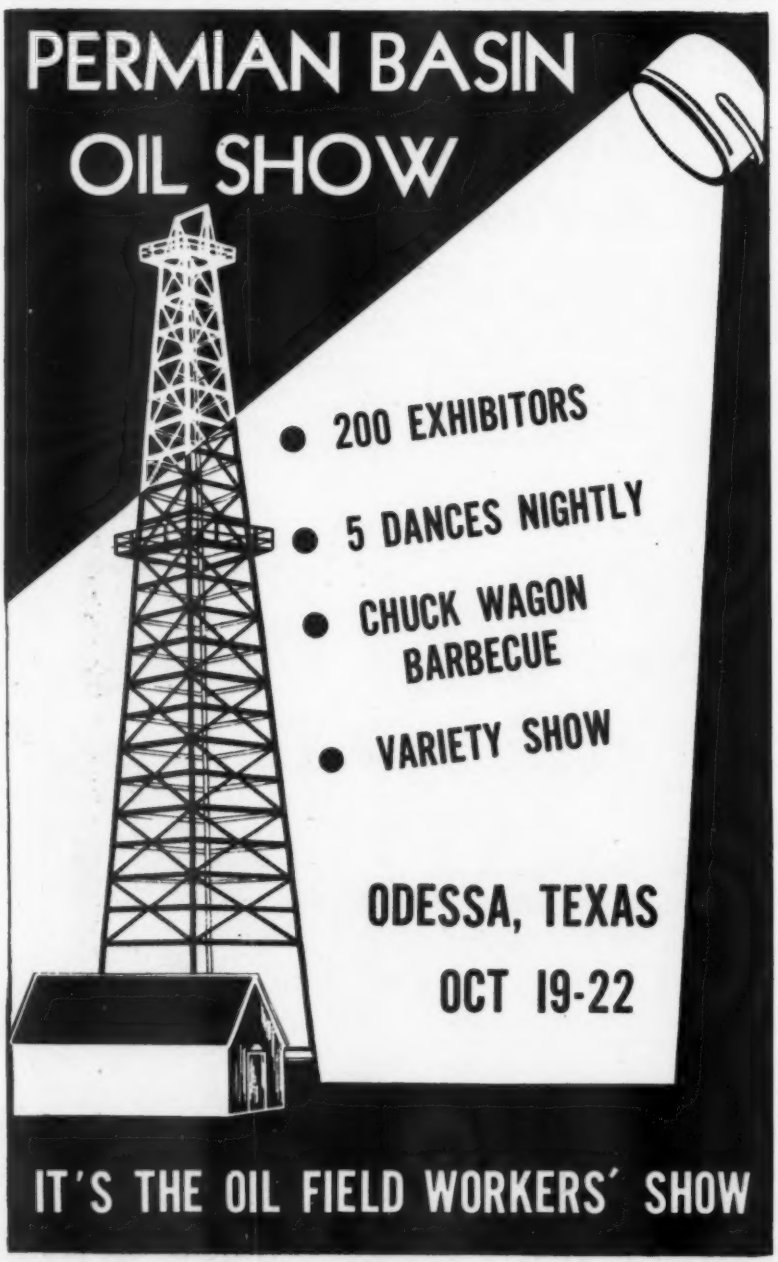
Swabbing line should be strung on middle sheave of crown block or on a special swabbing sheave.

Any instrument used in derrick for racking or unracking pipe should have proper safety line attached to it.

Dead-line anchor sheave should always have U-straps to prevent line from jumping out of sheave..

Nails should not be used to replace cotter pins on rotary chains.

Drilling line should be dead-ended to the base of the derrick directly opposite the draw works. Under no cir-



cumstances should the deadline be anchored to the derrick corner on the same side of the draw works, because this would reduce the capacity of the legs 40 per cent.

Finger board should be attached to the derrick with an auxiliary line of light cable to prevent its falling should the hook or traveling block break it loose. It is recommended that fingers on fingerboards be bound with wire to prevent pieces from falling in the event they are broken off.

Pipe left standing in the derrick should be securely tied, so that wind cannot cause it to shift and throw undue strain on the derrick.

When using ordinary U-bolt-type cable clamps, always have U-bolt over the short end of cable, and clamp over the part of cable which carries the load—or the long end.

Case History: Stabbing Board Accident

During the process of running 10¾-in. casing, a drilling-crew member was engaged in guiding elevators over top of a long joint. He lost his footing on stabbing board and grasped top of the 10¾-in. drill collar to prevent falling. Casing elevators sat down on top of collar at that moment, and one of the elevator bails caught the ring finger of employe's left hand between the elevator bail and top of the collar.

Direct cause: Slippery surface (improper installation).

Basic cause: Nonskid material was not provided for stabbing board and stabbing board was not at right height.

Recommendations: Keep stabbing board adequately covered with nonskid material. Change height of stabbing board when necessary. Design and build adjustable stabbing board.

COMPLETION PRACTICES

In well shooting, while the shot is being run or while the time bomb is being prepared, the crew and all persons not connected with the shooting should remain at a safe distance from the well—at least 250 to 300 yd. away.

When drilling in with oil, circulation should be through a separator and tank at least 100 ft. from the well. Accumulation of oil on the pits should be kept at a minimum. If dead oil is being circulated, the trap may be bypassed.

A well head capable of sealing off pressure is recommended to eliminate the overflow in the cellar and the escape of oil or gas on and under the floor.

Workmen, except service-company employes, should remain a safe distance from the perforating gun while it is being loaded or unloaded.

Before acidizing operations are begun, workers should check the working pressures of all well-head and injection-line fittings to be sure they will withstand any injection pressure encountered.

As some of the acid used for acidizing may contain auxiliary reagents which are dangerous to skin cuts, all actual handling of the acid, including repair of acid leaks in injection lines, should be left to the acid company's employes.

When pumping acid at high pressures workmen should remain a safe distance from the injection lines and pumps as the failure of a gasket or some other equipment might cause the employes to be sprayed with acid.

The location of a fresh-water source should be pointed out to all members of the rig and acidizing crews before acidizing operations commence. Acid accidentally spilled on the skin or clothing and leather shoes should immediately be washed (flooded) off with water.

When using swabbing, bailing, coring, or survey line, the employes

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Shale and abrasives don't have a chance to chew up expensive drilling equipment when drilling mud is conditioned with a Thompson Shale Separator ... *only clean mud* goes back into the well. If you are drilling deep, you'll want the Thompson "DWF," capable of handling maximum flow from the biggest mud pumps now in operation. Two other models available for shallow and medium depth wells. Attached SAMPLE MACHINE provides accurate foot-by-foot samples of cuttings.

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should not stand near the hole, as it might part or throw slack causing them to be struck by or entangled in the line.

Sufficient flags should be placed on the line as an indicator to stop the swab at a safe distance from the oil saver.

If a person's clothing becomes saturated with oil while bailing, swabbing, making drill-stem tests, etc., he should remain at a safe distance from the boilers, tractor, or any other source where a fire hazard may be created. Clothing should be changed as soon as possible.

PRESSURE PIPING SYSTEMS

Line pressure should be relieved before a line is broken.

A high-pressure line should never be opened or closed suddenly.

Bleeder, fillup, or flow lines or any line subject to high rate of flow should be made fast at the end to prevent line from swinging or jumping when pressure is turned into line.

Before beginning any repair work on any piece of equipment usually operated under pressure, such as mud pumps, steam manifolds, steam engines, pressure and injection lines, pressure vessels, or any equipment under pressure, special care should be taken to see that pressure has been released.

Workers should not hammer or pound on lines, fittings, vessels, or equipment under pressure.

A valve should never be opened or closed unless the worker knows what purpose it serves. Valves should not be jammed open.

A leaking valve on any high-pressure connection should never be stopped with a bull plug. A nipple and an extra valve should be used and the extra valve should remain open while the connection is being made.

SAFE PRACTICES

A cable is preferable to a chain for raising or lowering any heavy equipment.

Drive belts should not be tightened while they are in motion.

Tools, equipment, and material should not be thrown up or down from one working level to another. They should be carried or sent up or down by a safe method. When climbing ladders both hands should be kept free to assist in climbing.

Gage glasses should be changed whenever they lose their transparency. Tubular-type gage glasses

Case History: Goggles

The driller and floor man were preparing to cut off a section of 1⅛-in. steel drill line. The driller looked around for goggles and found that there were none on the derrick floor. Goggles were actually provided at this rig; however, the drilling crews had been mixing caustic soda and had used the goggles and after completing the mud mixing, had left the goggles in the mud house. Other goggles were stored in the tool house but rather than walk a few steps to get the goggles, the floor man decided to go ahead and make the wire-line cut without their protection.

The driller directed the floor man to stand by while he made the cut, himself, since the possibility of flying steel might injure the floor man's eyes and if injury was to occur, the driller preferred that it occur to himself. The driller then proceeded to strike the wire-line cutter with a sledge hammer. After two or three strokes, two pieces of steel wire left the wire line and entered the driller's eye. The employe was taken to an eye specialist where the foreign objects were removed in a very delicate operation. At the present time it appears that the employe will suffer no permanent impairment of vision.

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should be properly guarded and goggles should be used when changing gage glasses.

Cans (Underwriter's approved type) with flexible spouts should be used when filling gasoline tanks. Gasoline should not be supplied to an engine fuel tank while the engine is running.

Belt dressing should be applied to the center of the width of the belt on the outgoing side from the pulley. V-belts or V-belt pulleys should not be dressed in any event.

Cast iron subjected to pressure, strain, or vibration should not be welded.

When preparing to cement well, space nipples should be used where possible to permit men to work on floor and eliminate use of stabbing board.

Should derrick be pulled in during pulling of pipe or casing, it is liable to happen when pulling the first stand. Therefore, derrick man should not start up ladder until first stand of pipe has been pulled and set on slips.

Workers should never depend on lift jacks. Blocking should be used to prevent objects from falling, and workers should never get in unsafe positions under or near unblocked objects resting wholly on lift jacks. Jack handles should be removed when the jacks are not being used.

Motors should be equipped with mechanical starters. However, when cranking motors that require manual starting the acceptable grip of placing the thumb alongside the handle should be used.

Internal-combustion engines should have switches to kill the motors. Engines should not be stopped by removing the spark plug wire.

DRILL-STEM TESTS

Recommendations which follow are in accordance with the Drill-Stem Test Committee of the American Association of Oil Well Drilling Contractors, as recommended to the fourth annual safety clinic of the association.

1. **An informal meeting** should be held, prior to going in the hole. In order that everyone will know how the job is to be done, all persons participating in the taking of a drill-stem test, such as contractor, operator, and employes, should be present. Such items as safety factors, exits, and wind direction, etc., should be discussed.

2. **One person only** should act as supervisor in giving orders and it should be understood by everyone concerned.

3. **It should be** made mandatory that every man working on the job should wear safety hats and safety shoes.

4. **Mud** should be conditioned to resist any possible blowout that may be encountered.

5. **Fillup lines** should be installed on the drilling nipple above the blowout preventer to keep the casing full of mud, and should be used only for this purpose. Provisions for kill line should be made separate.

6. **Blowout preventer** should be checked before going in the hole, also before coming out.

7. **The cellar** should be jetted, providing no drain is available.

8. **All heating stoves** and open fire should be extinguished as a precautionary measure to prevent a fire hazard.

9. **All ignition wiring** should be properly insulated on motor rigs.

10. **On electric rigs** the blowers should be operating properly.

11. **All generators** should be disconnected or shut down.

12. **All steam rigs** should be disconnected or shut down.

13. **All exhausts** on motor rigs should be wrapped in asbestos to prevent a fire hazard.

14. **Water connection** to manifold should be checked for proper spray.

15. **All high-pressure swings** should be snubbed or anchored down.

16. **Mud guns** should be installed in such a place that in case of fire they can be used on or under the floor.

17. **All fire-fighting equipment** should be inspected before starting the tests to be sure they are full and in workable condition.

18. **All persons,** either workmen or visitors, should leave all smoking tobacco, such as cigarettes, cigars, pipes, etc., and all matches and lighters in their car or doghouse, so as to prevent anyone from unconsciously using smoking tobacco.

19. **Warning signs** should be installed to warn visitors and drivers of vehicles to be cautious when entering the lease.

20. **Driller** should designate the responsibility to one of his crew members to see that the casing is kept full of mud at all times while going in or coming out of the hole.

21. **Hose** should never be taken off to let the well flow through the kelly and out of the gooseneck, especially on a portable derrick.

22. **Pipe size** and condition should be analyzed before considering a deep-hole test, to prevent drill pipe from collapsing provided it is not to be filled with water.

23. **One experienced cathead man** should operate the cathead at all times.

24. **No drill-stem** test should be conducted at night, but should be so arranged to finish before dark.

25. **No test** should be conducted during electrical storms or rain storms, due to static electricity.

26. **In turning drill pipe** with tongs or wrenches to operate the tool, under no circumstances should more than one tong or wrench be used. If more power is needed, use a longer-handled wrench. Cheaters and spinning lines should be prohibited.

27. **An opening** should be made available in the windbreaker so the derrick man will have immediate access to his safety slide.

28. **Derrick man** should check his safety slide and line to be sure it is workable. Be sure the line is not coated with ice.

29. **Due to so many** different types of tool joints, every rig should be equipped with a safety tool plug for each string of pipe.

30. **Mud box** should be rigged up with a flexible line extending from flow line to the floor with a quick union.

Capillary-Pressure Method

(Continued from page 229)

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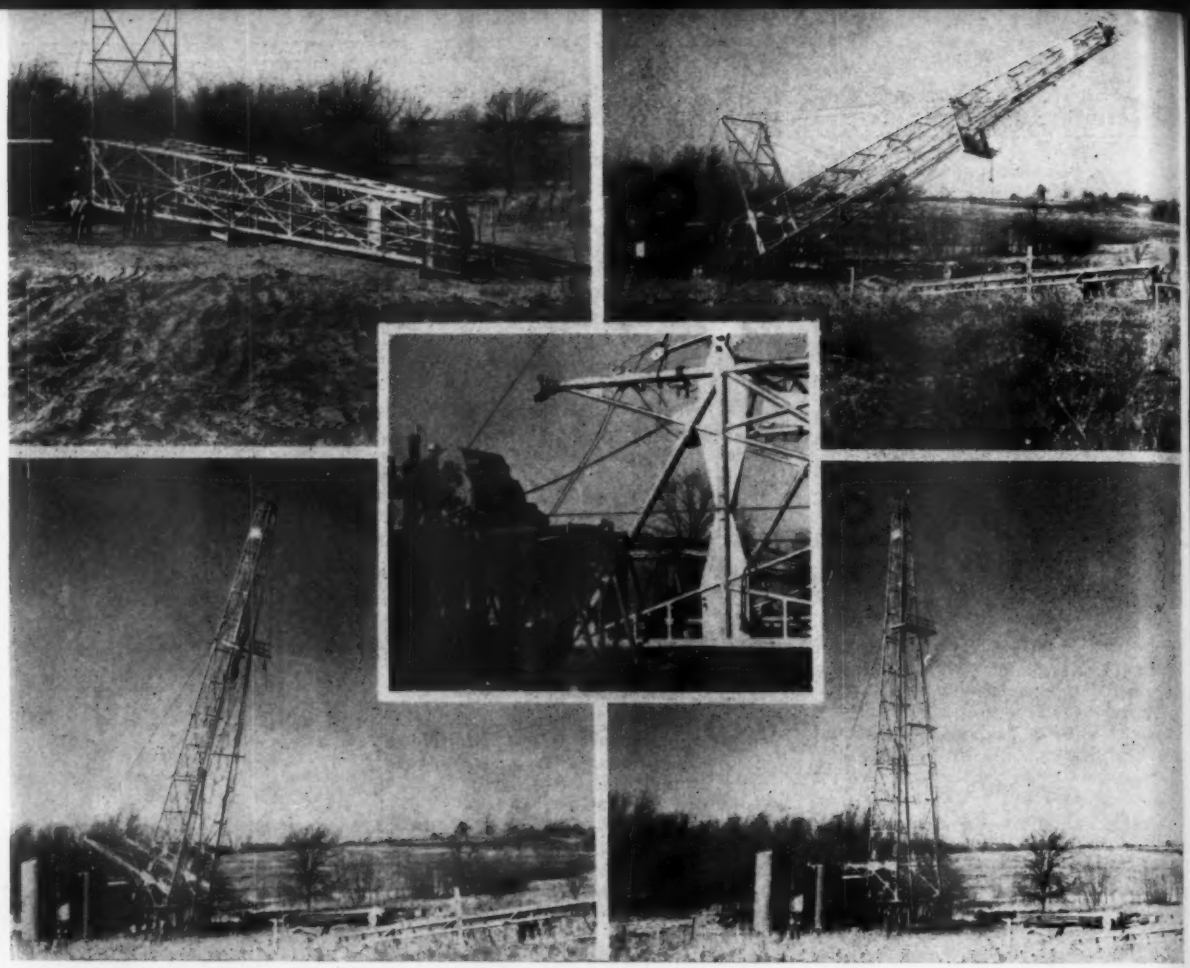

These photos illustrate rigging method for the new portable steel derrick. The derrick raises directly from the ground on two pivot points (instead of one) and using both front and rear legs. Upper left: The assembled derrick is raised from a horizontal position, front legs hinging on a shaft at the bottom rather than the top of the derrick base (inset). Upper right: Draw works pulls derrick upward as it swings on front legs. Lower left: Rear legs, reaching floor level, are connected on a second shaft which becomes the pivot point. Lower right: Front legs are unlocked and raise to floor level, as the derrick completes the swing to vertical position.

New Portable Derrick Erects Quickly to Floor Level

"Walking up" to the derrick floor, for its erection, is an installational feature of a new portable steel derrick which incorporates a streamlined rigging method and numerous safety features. The tubular steel derrick is erected directly from the ground. It was designed primarily for use on the higher substructures used in today's deeper well drilling.

The derrick does not require gin-pole trucks to raise it to floor level. It "walks" itself up onto the derrick floor, employing two pivot points instead of one and utilizing both front and rear legs in the 90° swing into vertical position and in lowering.

Many portable derricks now are set on bases as high as 10 ft. Ordinarily this is done by lifting the lower end of the derrick frame to the top of the derrick base with large gin-pole trucks before it is pivoted upward on the front legs to the vertical position. This operation is eliminated, and there also is a reduction in load raising requirements since the new derrick is lifted from horizontal rather than from a sloping position between the substructure top and the ground.

After it is assembled on the ground, the frame slides along a built-in guide to a hinge point at the bottom of the derrick substructure. There, circular shoes on the front legs slip over a tubular shaft. The derrick frame revolves on this shaft as the draw works pulls it upward to an angle of approximately 23° vertical. At this point similar shoes on the rear legs make contact with a second shaft at the floor level of the substructure. They are connected and the front legs are unlocked. The derrick then pivots on the rear leg shoes to complete the arc, the front legs raising to the leading edge of the substructure floor where they are seated on a suitable shaft that easily slides into place.

In this method of raising and lowering, the load on raising lines is reduced and less load is imposed on the draw works. During the raising operation only a positive pull is required. The center of gravity at no time passes over the pivot point. This eliminates the necessity for snubbing or easing the derrick into final position. Two experimental models of the new design have been in operation for some time on locations in Oklahoma and South Texas (see photos).

The new model derrick, named "128-B" by Oil Well Supply Co., is joined together by special flanges and designed to afford clear upward vision. The drilling line is located within the derrick, enabling the driller to keep sight of the traveling block at all times. The derrick consists of three main sections which are assembled on the ground at location, as discussed. Crown block and traveling block are strung completely for drilling and the entire derrick raises as a unit. It can be transported in three truck loads.

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We want all our old customers who are operating in this area to use to the full our facilities there. Also to the operators who have not known us before we will welcome any chance they will give us to be of service to them.

Our telephone number at Snyder is 1353.

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For oil refineries, chemical plants, processing, pipelines, drilling, truck and tank car loading racks. Individual joints or multi-joint flexible steel hose, RAMSCO's patented method of packing offers proven dependability for continuous or occasional rotation service.

360° FREE ROTATION—1, 2 AND 3 PLANES

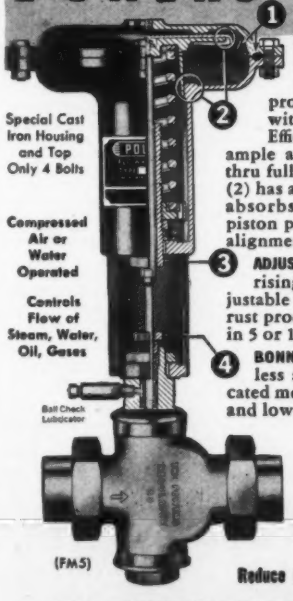
Your particular piping problems solved. You name it—we have it. Over 500 sizes, types, styles. Sizes: ⅛" to 14" low pressure; ⅛" to 6" high pressure. Corrosive service or steam fittings 1000 psi. and temp. to 750° F., asbestos or Teflon packed. Low pressure fittings to 1000 psi. and temp. to 225° F. High pressure fittings to 15,000 psi. and temp. to 225° F. Gear driven types available.

Send for complete catalog and prices. State kind of service, pressure, temperature, pipe size and indicate style below, threaded, flanged or weld ends.

RASMUSSEN MFG. CO.

RAMSCO 12305 INDUSTRIAL AVE. HOLLYDALE, CALIFORNIA

Get BETTER Control with POWERS FLOWRITE VALVES



VALVE TOP—Durable moulded neoprene diaphragm (1) has positive sealing bead which provides increased sealing action with increasing control pressure. Efficient diaphragm form insures ample and constant operating power thru full travel. Piston Plate Assembly (2) has a free floating thrust plate which absorbs side thrust. Closely guided piston plate maintains stem in accurate alignment.

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BONNET ASSEMBLY—Polished stainless steel stem in preformed lubricated metallic packing insures long life and low hysteresis.

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For line pressures below 250 psi. Rugged construction to withstand piping strains.

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SOLD AT SUPPLY STORES EVERYWHERE

PETROLEUM DISTRIBUTING CO.
BOX 203—HOUSTON, TEXAS
CHarter 5648

New Portable Drilling Mast

(Continued from page 192)

long and are equipped with self-aligning pivot bearings at ground level and with rollers at their upper ends. The block-and-tackle mechanism consists of a sheave fixed inside the mast leg just above the pivot point; another sheave attached to the raising leg at its upper end; and a sling line anchored at one end to the lower sheave, then passing over both sheaves, and finally anchored at the other end to a sling yoke which rides in the traveling-block hook.

When the traveling block is raised by means of the draw-works drum, the sling lines exert a pull at the upper ends of the raising legs, causing them to rotate upwardly about their pivots. The rollers, riding in tracks that run down the inside of the mast uprights, exert an upward pressure on the mast structure, causing it to tilt from a horizontal to a vertical position.

The line pull required to raise the mast is 10,500 lb. with six lines up. As the mast rises, the load on the raising lines decreases, becoming almost zero as the mast reaches vertical position. When the mast is in the final vertical position, its center of gravity is located slightly on the pipe-rack side. Upon releasing the locks which hold the mast upright, the mast will tend to start downward of its own accord without having to be jacked or pulled over dead center. When the mast is raised and locked into position the raising lines are disconnected and stowed in coils just below the mast-leg base pedestals.

Locking Device

An automatic device is provided to lock the mast in the vertical position as it reaches the end of its upward travel. There are four locks, two in each leg, consisting of a spring-backed plunger or pawl and a toothed cam. The cam contains a circular cut-out that fits around the roller shaft on the raising legs. The mast uprights are fitted with a plate in which a matching roller-shaft seat has been cut. When the roller shaft in the raising legs reaches the bottom of its travel, as the mast reaches vertical, it comes to rest in the seat fitted to the mast. As it approaches the seat, the roller shaft engages a toe in the locking cam and causes the cam to rotate, much in the same manner as a hook locks when engaged by the swivel tail.

When the cam rotates, an arm an the cutout on the cam come down over the top of the roller shaft, holding the shaft against the seat in the mast. Also as the cam rotates, the

TIME-TABLE SAVINGS IN THE FIELD

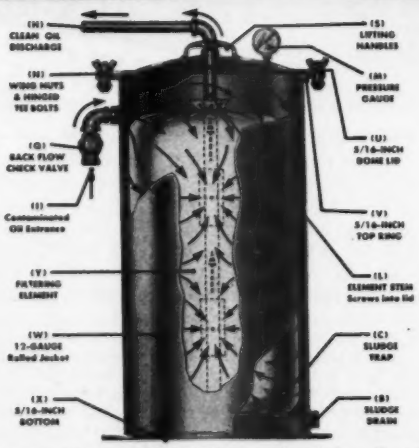
THE ENARDO "MB" TIME CYCLE SWITCH
An accurate micro-switch control mechanism for all types of electrical circuits. Operates on either open or closed circuits. This hand wound clock mechanism has proved its economical efficiency in field operation of remote pumping engines. The non-arcing, vapor tight switch has a normal operating capacity of 60 Watts D.C., 1250 Watts A.C.

THE ENARDO "W" CLOCK SHUT-OFF VALVE
The Enardo "W" is ideally suited for any liquid or gas flow lines where line pressures do not exceed 100#. Cast iron . . . stainless steel trimmed . . . a dependable clock mechanism that is protected by a dirt, moisture, and vapor resistant case. Pays for itself by slicing return trips.

THE ENARDO "A" TIME CYCLE SWITCH
A companion switch to the "MB" series, the Enardo "A" employs a mercury tube switch operation in place of the micro-mechanism. Available in 12 and 24 hour settings the "A" series is of the single circuit type, rated at 4 Amps., 115 V., either AC or DC. For more detailed information on any of the above items write Enardo, Box 1647, Tulsa.

ENARDO Manufacturing Co.
TULSA, OKLA.

Here's Why SUN FILTERS CUT LUBE COSTS!


(H) CLEAN OIL DISCHARGE
(S) LIFTING HANDLES
(N) WING NUTS & HINGED YEE BOLTS
(R) PRESSURE GAUGE
(Q) BACK FLOW CHECK VALVE
(U) 5/16-INCH DOME LID
(I) Contaminated Oil Entrance
(V) 5/16-INCH TOP RING
(Y) FILTERING ELEMENT
(L) ELEMENT STEM Screws Into lid
(W) 12-GAUGE Rolled Jacket
(C) SLUDGE TRAP
(X) 5/16-INCH BOTTOM
(B) SLUDGE DRAIN

You save because SUN Filters *refine* lube oil as they filter! Cross-section above shows many exclusive features of SUN'S Regular Flow Filters. Also available in dual flow and for diesel fuel!

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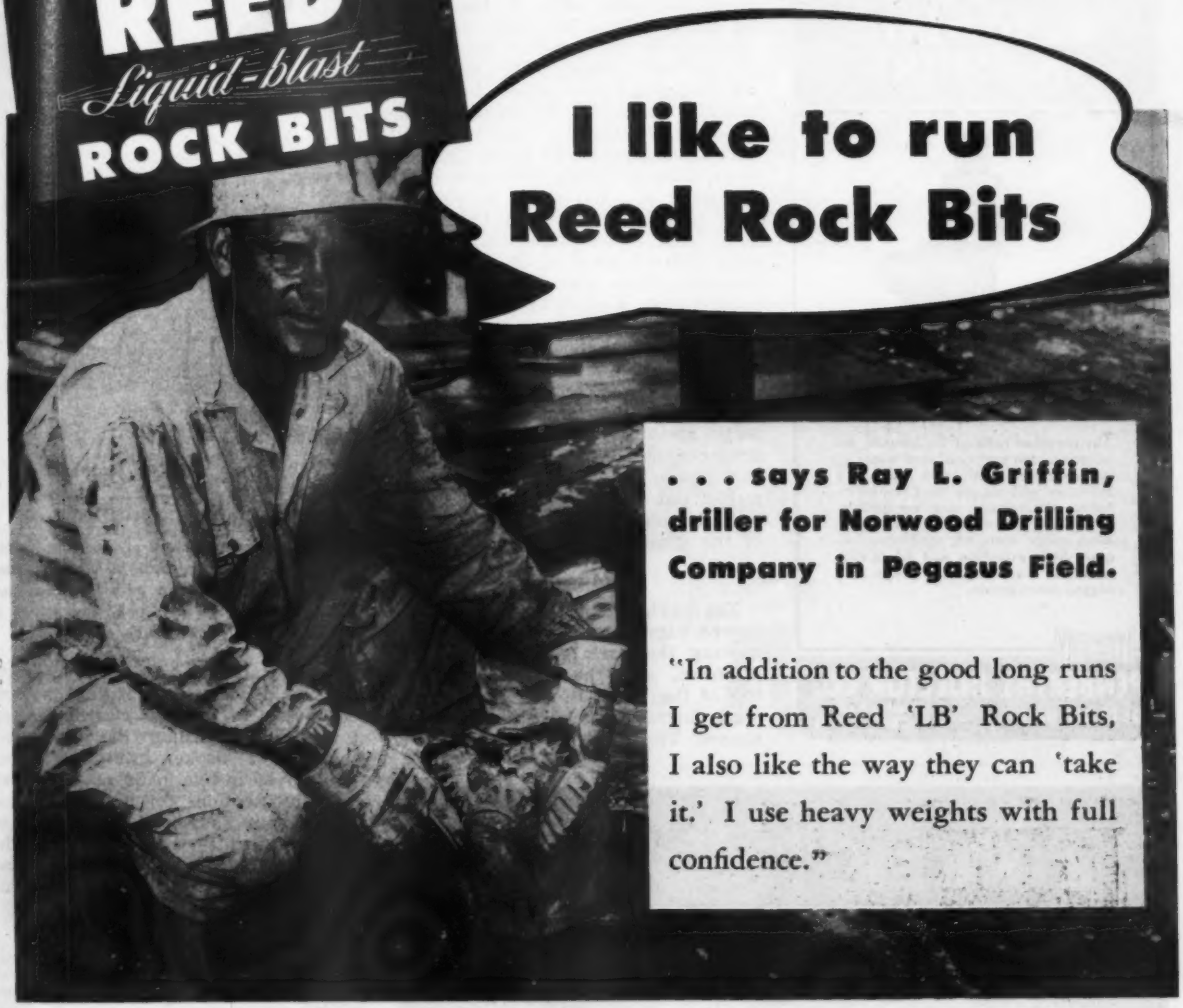
REED
Liquid-blast
ROCK BITS



I like to run Reed Rock Bits

. . . says Ray L. Griffin, driller for Norwood Drilling Company in Pegasus Field.

"In addition to the good long runs I get from Reed 'LB' Rock Bits, I also like the way they can 'take it.' I use heavy weights with full confidence."

For good, long runs use the Reed "LB"

Reed Liquid-Blast Rock Bits drill faster and give more footage per bit because they clean the bottom of the hole as they drill. Try going Reed all the way on your next well and see for yourself how much Reed "LB" Rock Bits can save you.

The Reed 2HS-1 series of Rock Bits are giving outstanding runs in West Texas lime and chert.

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AUTOMATIC
INJECTORS

The accepted method for assuring an uninterrupted supply of feed water to oil field boilers. Penberthy Automatic Injectors will supply feed water to boilers at minimum cost, are quickly and easily installed, reliable under most severe operating conditions, require little attention and no careful handling. Highest quality design and rugged construction.

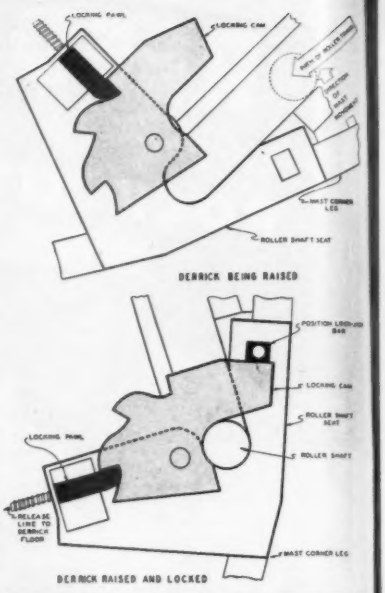
PENBERTHY INJECTOR CO.
DETROIT, MICH. Canadian Plant WINDSOR, ONTARIO

spring-backed pawl rides up over successive teeth in the cam and falls into position behind each of them with an audible click. The pawl must rise over two of these before the mast is vertical and locked. After the pawls have engaged the second tooth, the mast is automatically locked in the vertical position by the pawl-and-cam arrangement. To make the lock even more positive a lock-jack bar is manually inserted above the locking cam into holes cut into the roller-shaft seat so no movement of the raising mechanism or of the mast is possible. When the mast is erect the raising legs support one-third of the hook load.

To lower the mast, the lock jacks are removed manually and thereafter operations are controlled from the derrick-floor level. The automatic locks are disengaged by pulling on lines connected to the pawls. Freed of the pawls, the roller shaft will be pulled out of the seat and the mast will descend against braking action of the draw works.

Moving

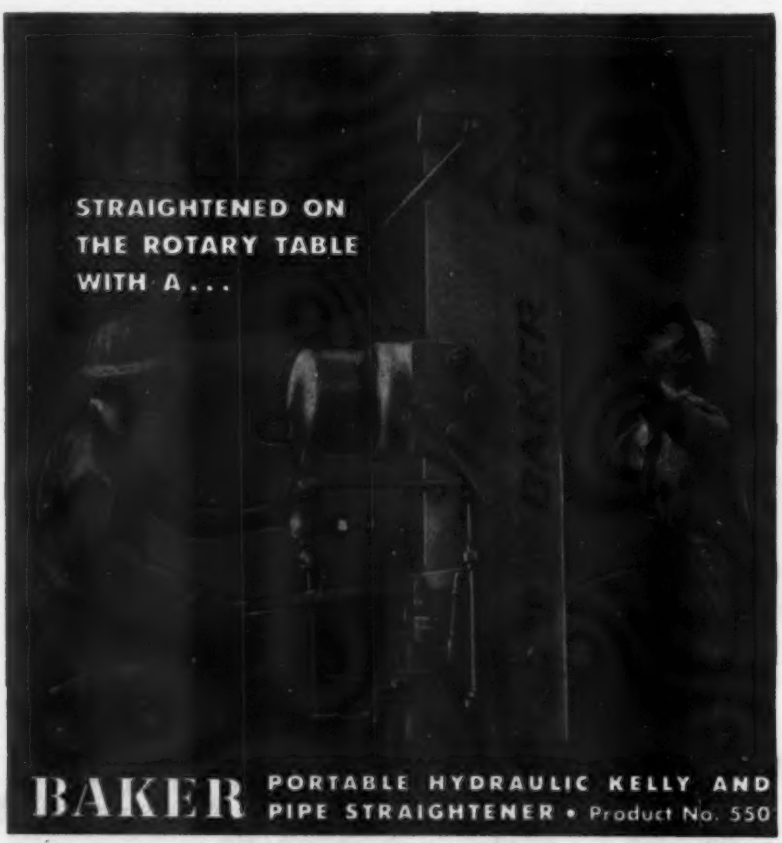
The uprights of the mast may be moved together when lowered by removing the back strut, the racking platform, and the X-braces at the top of the mast. In this position the mast forms a package that is 7 ft. square. The mast may be moved in the field in any one of four ways: (1) Skidded in the upright position, (2) moved in lowered position as one piece with or without the legs folded together, (3) broken into two sections and moved in two loads, or (4) broken into five sections for highway transportation in four loads. For ocean or rail shipments the mast may be knocked down into flat panels and individual parts, thus providing minimum cubage.



Schemmatic arrangement of the mast-locking device. When in its upright working position the mast is locked with the pawl and cam and with a lock-jack bar which is placed manually above the cam.

SPECIFICATIONS

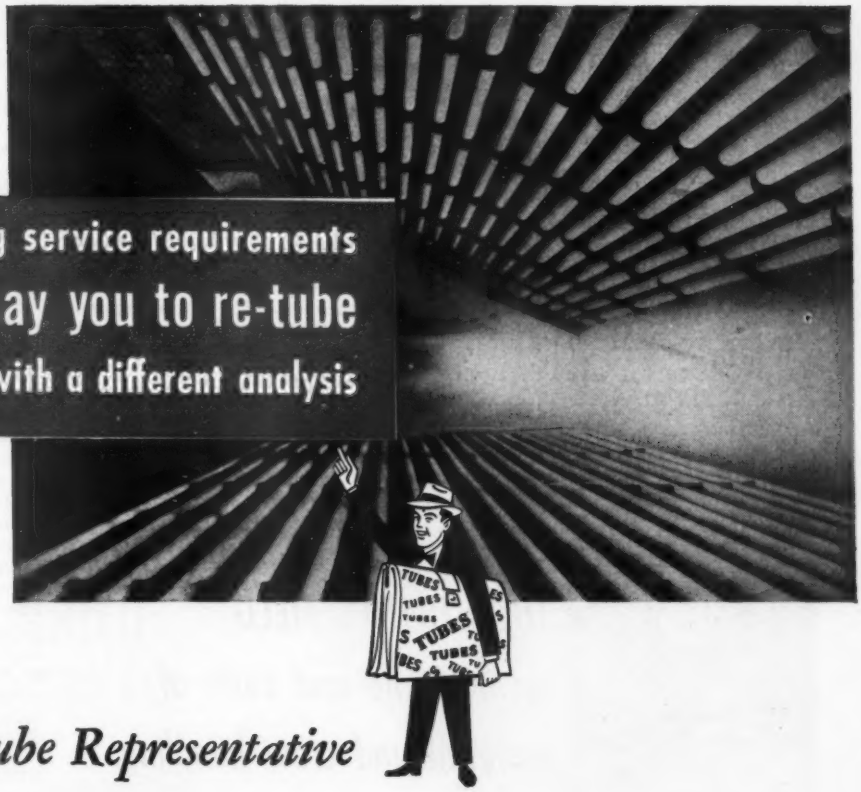
Gross capacity, lb.	566,000
Clear height, ft.	133
Weight, mast, lb.	52,000
Weight, substructure, lb.	37,000
Height, substructure for mast described, ft.	8
Width, between center line of mast leg base shoes, ft.	24
Over-all floor width, (ft.-in.)	27-8
Length of substructure, mast described, ft.	52
Pipe capacity, 4½-in. drill pipe, ft.	12,975
Raising load line pull, six lines up (on hook), lb.	10,500



Safety on the Job

A reduction of 90 per cent below the accepted average for disabling injuries is reported to have been achieved by H. C. Price Co., Bartlesville, Okla. This record has been made in operations that involve four main-line spreads and approximately 1,500 workmen.

During the first half of 1950, Price construction crews established the low average of 21.7 for disabling-injury frequency per million man-hours. This figure compares with a rate of 92.1 set for the same period in 1949 by these four spreads, and a frequency of 133.1 for the first 6 months of 1948.



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B&W REFINERY TUBING

. . . a wide choice of service-proved analyses* to meet *all* conditions of pressure, temperature, corrosion and oxidation.

Carbon Steel	
Carbon Moly Steel	(½% Mo)
Croloy ½	(½% Cr, ½% Mo)
Croloy 1¼	(1¼% Cr, ½% Mo)
Croloy 2	(2% Cr, ½% Mo)
Croloy 2¼	(2¼% Cr, 1% Mo)
Croloy 3-M	(3% Cr, 1% Mo)
Croloy 5	(5% Cr, ½% Mo)
Croloy 5-Si	(5% Cr, ½% Mo, 1½% Si)
Croloy 5-Ti	(5% Cr, ½% Mo, ½% Ti)
Croloy 7	(7% Cr, ½% Mo)
Croloy 9-M	(9% Cr, 1% Mo)
Croloy 18-8-S	(18% Cr, 8% Ni)
Croloy 16-13-3	(16% Cr, 13% Ni, 3% Mo)
Croloy 25-20	(25% Cr, 20% Ni)

*The above list indicates only the more popular B&W Tubing Steels for Refinery Service and does *not* constitute the complete range of grades in which B&W Tubing is produced.

Today's diversity of petroleum processing operations imposes a greater variety of requirements than ever before on alloy and stainless refinery tubing . . . makes proper selection of analyses increasingly difficult. Your B&W Tube Representative may be able to show you . . .

FOR EXAMPLE

. . . how, in a given service, re-tubing with certain lower grades can give savings in initial cost without materially affecting performance; or how, under different conditions, switching to a higher alloy can pay service dividends far beyond a negligible increase in cost. Consult *your* B&W Tube Representative—his factory training in cost-saving "tube technics" and broad knowledge of refinery applications can help you decide whether you are expecting too *much* . . . or too *little* . . . from your present tubing.

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TA-1578-S

SAFETY COLOR CODE

for Drilling Rigs

SAFETY COLOR CODE FOR DRILLING RIGS

These recommendations have been standardized by the American Association of Oilwell Drilling Contractors:

BASIC COLOR SCHEME

Safety red.—To designate fire equipment, apparatus, and installations.

Safety yellow.—To point out strike against, falling, and stumbling hazards.

Safety orange.—To warn against equipment that can cut, bite, pinch, explode, or shock.

Safety green.—To help the new crew members locate first-aid equipment, bulletin board, and safety signs.

Background or company color.—Any color that gives a pleasing contrast to the four specific colors of the code. Gray-green is popular as a background color. However, several other colors will give a pleasing contrast.

DISCUSSION OF COLOR CODE

The background color for the entire rig machinery, tool houses, dog houses, pumps, etc., should be painted a color that will contrast to the safety color code. Guard rails and enclosure guards should be considered as part of the background machinery.

Colors identified by numbers.—So that various paint manufacturers and buyers will know the desired shade of color specified in the code, the basic colors have been identified by Munsell numbers. These are recognized easily among paint firms and by O.D.C. (Oil Well Drilling Contractor) numbers for further convenience in identification, thus:

Safety red is O.D.C.-101 or Munsell 5.0R 4/16; safety yellow is O.D.C.-102 or Munsell 2.5Y 8/12; safety orange is O.D.C.-103 or Munsell 2.5YR 6/18; safety green is O.D.C.-104 or Munsell 5.0G 5.5/6.

SYMBOLS AND THEIR APPLICATIONS

Red.—To designate fire equipment, apparatus, and installations.

Symbol: Red square (O.D.C.-101) Munsell 5.0R 4/16.

Application: (1) All fire extinguishers; (2) red square to mark locations of fire extinguishers.

Yellow.—To point out strike against, falling, and stumbling hazards.

Symbol: Alternate diagonal stripes,

yellow and black, (O.D.C.-102) Munsell 2.5Y 8/12.

Application: (1) The traveling blocks; (2) the hook; (3) the swivel; (4) the elevators; (5) the rotary hose (steel).

The following equipment can be painted **solid safety yellow** or **striped yellow and black:** (1) Bottom edges of all steps at all landings on derrick stairs; (2) the tong retractor post; (3) the rathole; (4) edges of all raised platforms on the derrick floor; (5) edges of all steps around boiler and

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CHALKS UP NEW GAINS IN THE UTILITIES FIELD cutting time and costs of material and crew handling.

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COMBINATION BITS WERE PIONEERED AND PERFECTED BY A-1

Beginning in 1939, the engineering staff of the A-1 Bit and Tool Company was the first to start research on a fast digging, straight hole bit that would incorporate the best features of a fishtail and rock bit. Now proved and perfected, the A-1 Combination Bit is the fastest digging bit in the field. In some areas, A-1 Combination Bits have cut more footage than any two bits previously used. Straight hole qualities are proved by the fact that no well yet drilled with the A-1 Combination Bit has been more than ¾ degree off vertical. Put this extra speed, extra long life, straight hole bit to work for you! Benefit from the experience of the pioneer in Combination Bits.

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FOSTER FLOW TUBE

Gentile Patents

FIVE FEATURES for your Consideration:

1 . . . **Compactness** Note in the picture above the short axial length. Tubes 3" in size and larger are approximately 1 to 1½ diameters long, depending upon the velocity in the main. For high main line velocities (above 10 ft/sec. for liquids) tubes are less than 1 diameter in length.

2 . . . **Ease of Installation** Due to its compactness and because it requires no straight runs upstream or downstream, except near valves or regulators, the total space required for installation is but a small fraction of that necessary for other primary devices. It can be installed as readily as a fitting and in that section of the line most conducive to steady flow conditions. Moreover, it can be installed in the plant proper, eliminating the need for expensive vaults or housing.

3 . . . **Reversibility** The Foster Flow Tube is symmetrical transversely; upstream and downstream nozzles and ports are identical. This means that where processing calls for flow reversal, the meter can readily handle the changes.

4 . . . **Low Head Loss** Where head losses are important Foster Flow Tubes are designed with a main-to-throat ratio that provides negligible unrecovered head losses.

5 . . . **Accuracy** All Foster Flow Tubes are furnished with calibration curves obtained in laboratory tests simulating installation conditions and can therefore be guaranteed to an accuracy to meet any specification.

Foster Flow Tubes are recommended for a wide range of services metering the flow of liquids and wet or dry gases. They are available in all commercial pipe sizes with flanged or screwed connections. Standard lining is bronze but other materials are available. In writing for further information, give processing and installation details of your metering requirements.

FOSTER ENGINEERING Company

313 Lehigh Avenue — Union, N. J.

pumps and shell shakers; (6) the tong backup post.

If the underside of the monkey board is painted, it should be striped yellow and black.

Orange.—To warn against cut, bite, pinch, explosive, electrical hazards.

Symbol: Orange triangle, (O.D.C.

103) Munsell 2.5YR 6/18.

Application: (1) Two-inch stripe around rotary table; (2) 2-in. stripe along body of pipe tongs; (3) handles of rotary slips; (4) stripe around inside flange of cathead; (5) inside of all guards; (6) inside cover of all electric switch boxes; (7) handle for emergency throttle valve; (8) handle for spinning cathead control; (9) valves and valve handles and wheels on blowout-preventer equipment; (10) stripe on drum flange; (11) stripe on lower edge of elevators; (12) cover for mouse hole; (13) rotary drive bushing; (14) rotary brake levers.

Green.—For first-aid equipment,

bulletin boards, and safety signs.

Symbol: Green cross on white background, (O.D.C.-104) Munsell 5.0G 5.5/6.

Application: (1) First-aid kit; (2) safety bulletin board, with green cross on white background located at top center of board; (3) the following safety signs are recommended for rotary rigs (white background, safety green lettering): (a) **Safety first**—Do not come on derrick floor without your safety hat. (One at each set of derrick floor steps.) (b) **Safety first**—Watch your step. (One at each step without handrails.) (c) **Safety first**—Keep good tools on the work bench. (One at each work bench.) (d) **Safety first**—First-aid kit. (Inside building or tool house. (e) Wear your goggles (at grinding wheel). (4) Paint trash containers the background color with white star stenciled on them. (5) All walkways should have a white stripe along the outer edges.

South Texas A.I.Ch.E.

HOUSTON.—Petroleum derivatives which furnish a large part of the raw materials in the Gulf Coast's expanding petrochemical industry will be the subject of several papers to be presented at the fifth annual technical meeting of the South Texas Section, A.I.Ch.E. Date is October 2 at the Galvez Hotel, Galveston.

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And another rig moves on to location quickly, easily and safely with TULSA WINCH-mounted truck and tractors. In capacities ranging from 6000 to 80,000 pounds, Tulsa Winch offers 28 winch models for all makes and models of trucks and crawler tractors. For detailed information and specifications on Tulsa Winches, contact your nearest distributor or write direct to

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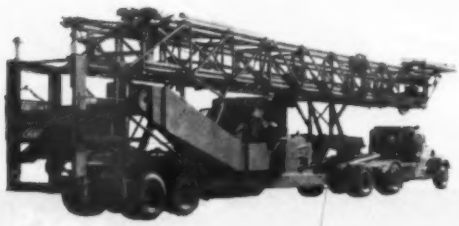
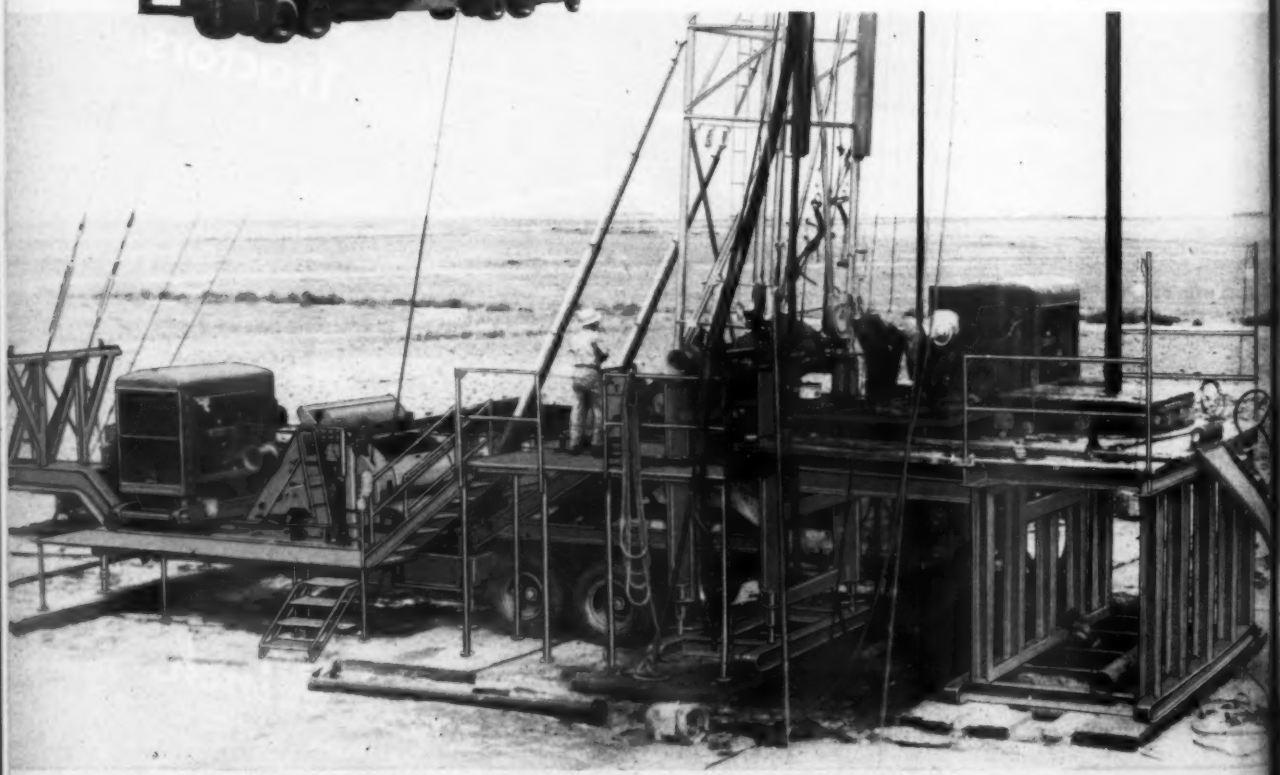
THE "Trailermast" can be used with any single engine draw works, and its lightweight and compact design gives you maximum portability and low-cost moves.

THE 16' x 16' derrick floor provides ample working space and is high enough for blowout preventers and wellhead connections. The "Trailermast" with draw works in place is quickly moved with a three- to five-ton truck tractor. Mast is erected with built-in hydraulic system and raised to full height with traveling block and drilling line. The complete rig is usually ready for work in less than three hours.



Cardwell "Trailermast" owned by a major oil company, on a 4,724-foot recompletion job in western Nebraska.



CARDWELL MFG. CO. INC. P. O. DRAWER 2001 WICHITA, KANSAS

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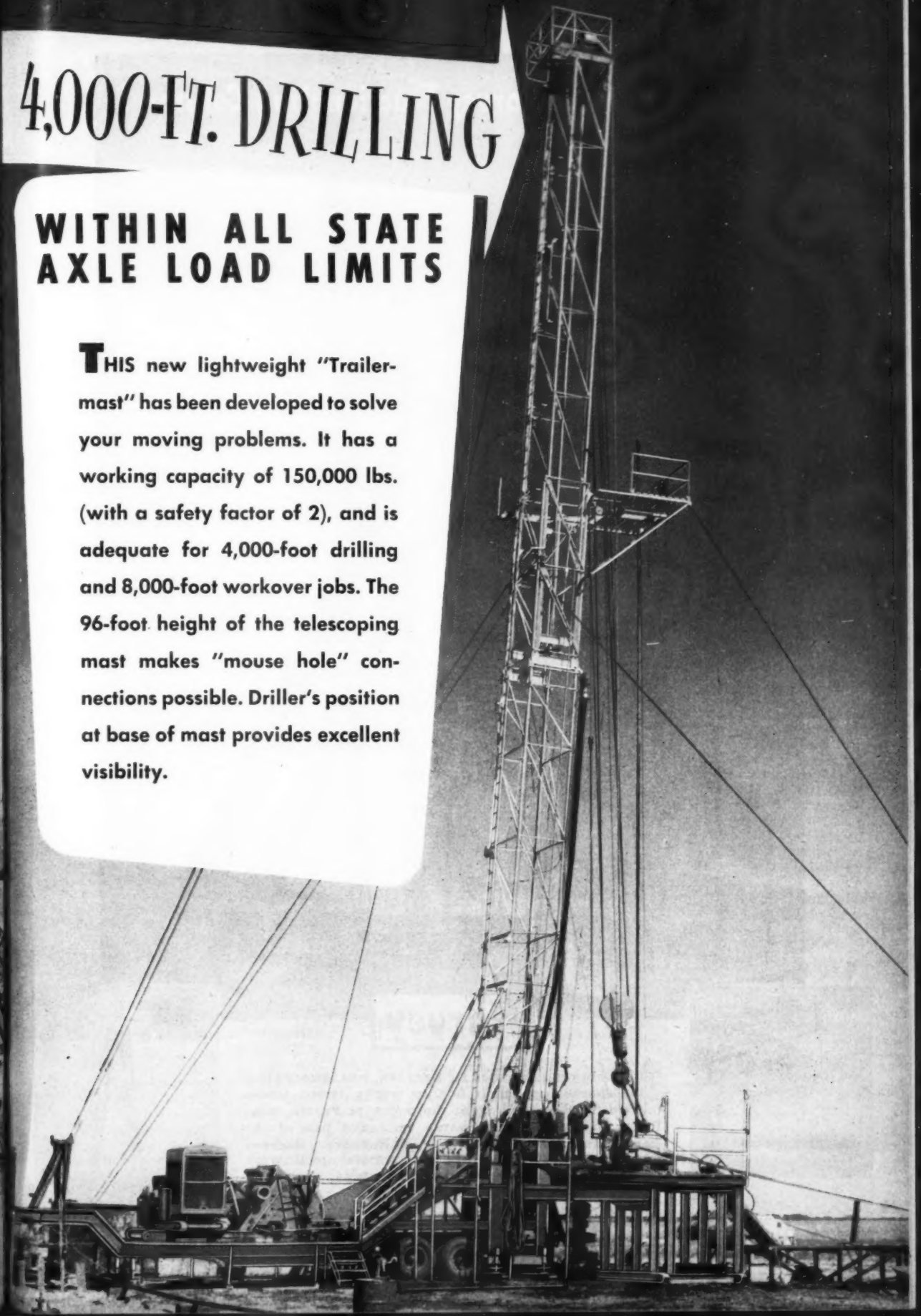
4,000-FT. DRILLING

WITHIN ALL STATE AXLE LOAD LIMITS

THIS new lightweight "Trailer-mast" has been developed to solve your moving problems. It has a working capacity of 150,000 lbs. (with a safety factor of 2), and is adequate for 4,000-foot drilling and 8,000-foot workover jobs. The 96-foot height of the telescoping mast makes "mouse hole" connections possible. Driller's position at base of mast provides excellent visibility.



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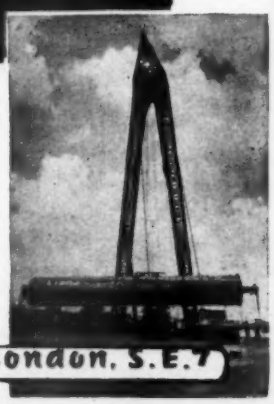
up goes another Harvey Fractionating Column!



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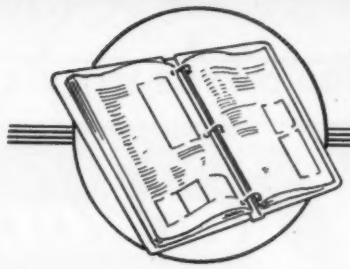

THE REFINER'S notebook

Process Lag and Load Changes

CONSIDERATION of the important characteristics of a controlled system include not only lag and dead time in system, but also load changes; specifically, it is important to know how large the load changes are and whether they occur suddenly or gradually. An additional consideration is the closeness of control desired (allowable deviation from the control point), as related to the control limits or scale range of the instrument.

Load changes.—In dealing with process lags in the preceding installment (September 28, page 103) a reboiler was used as an example to show how a process may be thought of in terms of a closed-control loop or circuit. The lags existing in this reboiling process were listed as (1) supply-side capacity lag, (2) transfer lag, and (3) demand-side capacity lag. The first is related to the amount of steam entering the heater in a given time, the second depends on the resistance to heat transfer from steam to liquid bottoms, and the third is related to the volume of liquid in the reboiler. Although not specifically stated in the previous discussion, the demand-side capacity would be influenced by the amount of liquid entering the reboiler in a given time as related to the amount of bottom product leaving the reboiler in that same time.

Changes in steam flow to the heater or in rate of withdrawal of liquid bottoms constitute load changes in this system. A liquid level controller could be placed on the reboiler to regulate rate of bottom product withdrawal. Cascade or interlocked control for regulation of steam flow may not be warranted in this particular case and it may be necessary to operate the reboiler with variations in steam flow.

Process reaction curve.—To see how the process behaves under these conditions use is made of the process response or reaction curve. This is not to be confused with controller response. (Refiner's Notebook, June 29, 1950, page 93) obtained when the system is under automatic control.

The process reaction curve may be obtained by plotting temperature of reboiler vapor against time or directly as a pen record, when the controller mechanism is cut off from the process and an artificial load change is introduced. The process reaction curve may be obtained sometimes by calculation. The value of the process reaction curve is that it indicates the time it takes for process recovery from an upset due to load change.

In Fig. 1 (top) three process reaction or recovery curves are shown. These are typical of systems having but one capacity. Usually temperature systems will have two capacities and the recovery curves will look more like the two curves at the bottom of Fig. 1. Ordinarily liquid level, pressure and fluid flow are single-capacity systems. If liquid level were plotted against time instead of temperature a recovery curve similar to those at the top of Fig. 1 would be obtained. The Curve 1 showing fastest recovery indicates a smaller capacity lag while the Curve 2 corresponds to a greater capacity lag.

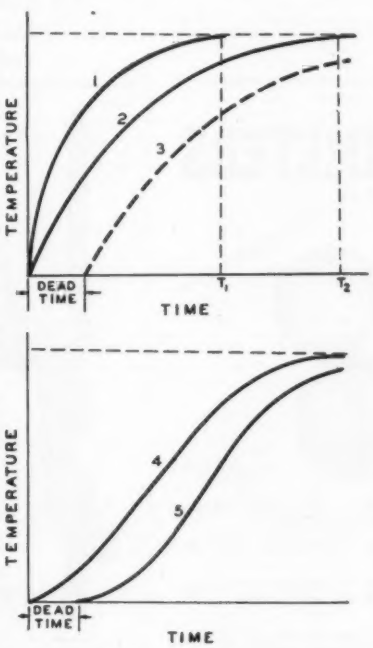

Fig. 1 — Process reaction curves are shown. These indicate process recovery from load change upsets. Curves 1, 2, and 3 are for systems with single-capacity lags. The dotted Curve 3 also shows dead time due to transportation lag. Curves 4 and 5 are for systems with multicapacity lags and transfer lag.

Distance-velocity or transportation lag was also mentioned in the previous installment. Its effect shows up as an actual time **delay.** The dotted Curve 3 is for a process which also has transportation lag. In this case the process does not even begin to respond to a load change until a certain time (termed "dead time") has elapsed.

Curves 4 and 5, Fig. 1, indicate a two-capacity system with a transfer lag between the two capacities, as in the reboiler. Curve 4 is for a small transfer lag, while the greater inflection in Curve 5 indicates a much greater transfer lag. The latter curve also shows dead time due to distance-velocity lag since the temperature does not begin to rise immediately with load change as is the case for Curve 4. The process represented by Curve 5 has additional dead time due to the slower rise of temperature as compared with Curve 4. Although both transfer and transportation lags may result in dead time, the former is a **retardation** effect while the latter is a direct time **delay.** "Retardation" means a slowing-down effect and refers to rate of change of temperature while delay refers to a period in which there is no change in temperature at all.

With understanding of the various process lags and their effect on process recovery when a load change upset occurs, it may be possible to plan the process for the most effective use of automatic control. Process elements may be arranged to reduce the over-all (cumulative) or "effective" lag of the control circuit.

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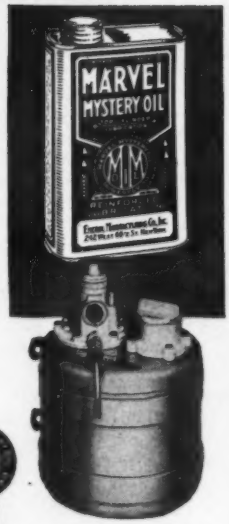

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"Cost-imating" Series

—Current Cost Indexes

Discussion—"Costs Versus Size"

WILLIAMS[37] and others have pointed out that the cost of plants increases as about the 0.6 power of the ratio of size:

$$C_A/C_B = (A/B)^{0.6}$$

in which A and B are the sizes or capacities of the two sizes of plants and C_A and C_B are their costs.

All of the data available in the Cost-imating series have been investigated as well as other sources, to determine the values of the exponent, as shown in Tables 1 and 2. Averages are not of much value in such a study but in general the exponent for complete plants (Table 1) is about 0.68 and for the major items of equipment (most of Table 2) the exponent is about 0.65.

Complete plants can be enlarged by increasing the sizes of the process equipment but certain parts are enlarged mainly by duplication. Thus, the exponent for complete plants generally tends to be larger than for equipment. Such parts as buildings, roads, bubble plates,[32] large pipe insulation,[15] and smaller flanged convections[42] tend to increase directly with size instead of the 0.6 power. The cost of other equipment tends to rise sharply with size, meaning that the exponent is not a constant but tends to increase. Such items as pipe-still bends,[18] centrifugal pumps,[19] smaller electrical motors,[20] cement-lined pipe,[16] Sharples centrifuges,[24] and steel (packed or bubble cap) absorbers[34] appear to behave in this manner. Finally, the exponent for some equipment is larger than 1.0 mainly by the greater thicknesses or weights required by high pressures. Thus, steel pipe costs[38] indicate an exponent of 1.18; valve cost[25] exponents rise sharply and tend to approach about 1.66; 150-lb. flange costs[29] approach an exponent of 1.8; 1,500 lb. of flanges[29] indicate even larger exponents and thickener costs[30] show exponents of about 1.07.

Such a wide variation in exponents occurs that great care must be used. An average exponent value of 0.60-0.65 seems appropriate for equipment whereas a higher value such as 0.7 may be a more nearly correct average value for complete plants.

TABLE 1—EXPONENTS FOR COMPLETE PLANTS

No.	Plant or process unit—	Exponent	Ref.
1.	Complete refrigeration plants (includes all auxiliaries)	0.85-0.96	8
2.	Complete refinery—catalytic cracking	0.85	1
3.	Catalytic cracking and topping—feed preparation, gas recovery and poly.	0.86	1
4.	Coke-oven gas separation	0.82	2
5.	Water—gas plant	0.81	2
6.	Water-treating plant	0.91	3
7.	Catalytic desulfurization	0.80	1
8.	Refrigeration units (no auxiliaries)	0.80-0.82	8
9.	Vacuum distillation	0.80	4
10.	Catalytic cracking (only)	0.78	1
11.	Solvent dewaxing	0.76	5
12.	Two-coil cracking	0.79	2
13.	Fischer-Tropsch	0.77	2
14.	CO and CO_2 removal from hydrogen	0.74	2
15.	Peterson sulfuric-acid towers	0.73	2
16.	Coking (only)	0.72	1
17.	Catalytic polymerization	0.70	1
18.	Soybean extraction	0.70	2
19.	Water—gas-shift conversion	0.69	2
20.	Sulfuric acid (contact)	0.64-0.66	2 & 6
21.	Styrene from ethylene and benzene	0.65	2
22.	Solvent extraction or treating	0.67	5
23.	Topping	0.67	5
24.	Platforming	0.66	7
25.	Vacuum flash	0.64	4
26.	Sulfuric acid (chamber)	0.60	6
27.	Oxygen plant—Process A	0.64	2
28.	GR-S rubber	0.63	2
29.	Oxygen plant—Process B	0.59	2
30.	Topping and thermal cracking (only)	0.60	1
31.	Oxygen plant—Process C	0.59	2
32.	Oxygen plant—Process D	0.58	2
33.	Topping (only)	0.58	5
34.	Natural-gasoline plants	0.51	5
35.	Thermal cracking (only)	0.51	5
36.	Small oxygen plant—Process B	0.47	2
37.	Hypersorption	0.43	5
38.	300-atm. hydrogenation stall (vapor phase)	0.33	2
39.	700 atm. hydrogenation stall (liquid phase)	0.31	2

TABLE 2—VALUES OF EXPONENTS FOR EQUIPMENT

Equipment—	Exponent	Ref.
Burners:		
Oil	0.82	17
Gas	1.06	17
Compressors:		
Gas-engine installations	0.89	23
Centrifugal	0.78	3
Reciprocating, 1 and 2-stage	0.90	3
Reciprocating, 3 and 4-stage	0.64	3
Average	**0.80**	
Crushers and grinders:		
Swing hammer bar	0.75	27
Jaw and rotary crusher	0.57	27
Ball mill	0.60	27
Roller crusher and mikro	0.66	27
Gynatory	0.70	27
Rotary cutters	0.62	27
Average	**0.65**	
Dryers:		
Drum	0.41	27
Rotary:		
Hot air	0.87	27
Flue gas heated	0.92	27
Spray	0.51	27
Evaporators:		
Standard vertical or horizontal	0.53	27
Long tube vertical	0.81	27
Forced circulation, C.I.	0.41	27
Filter presses:		
Sweetland	0.58-0.67	22
Oliver	0.69	22
Vacuum	0.48	3
Plate and furnace, C.I.	0.57-0.68	3 & 22
Plate and furnace, wood	0.35	22
Recessed plate and frame	0.58	22
Average (except wood)	**0.61**	
Furnaces:		
Topping stills	0.72	17
Steel tube stills	0.48	3
Cracking or pressure	0.61	17
Chrome steel tubes	0.80	3
General	0.70	31
Dowtherm	0.36	3
Average (except Dow)	**0.66**	
Gas holders	0.58	30
Gas producers	0.43	30
Heat exchangers:		
100-700 sq. ft.	0.43	9
700-1,400 sq. ft.	0.66	9
General	0.51-0.59	3
Water coolers (refrigeration)	0.68	24
Average	**0.57**	
Motors—very large:		
440-volt	0.84	21
2,200-volt	0.38	21
Pipe:		
Cement and clay (based on area)	0.74	16
Steel exchanger tubing	0.87	26
Average	**0.80**	
Pumps—Reciprocating:		
Piston	0.69	19
Plunger	0.75	19
Triplex	0.60	3
Average	**0.70**	
Structural steel:		
Tower platforms	0.74	14
Pipe-still structure	0.68	25
Average	**0.71**	
Tanks:		
A.P.I.—flat bottom, erected	0.52	10
A.P.I.—flat bottom, not erected	0.63	10
Spherical—100 psi.	0.45-0.63	3 & 11
Spherical— 25 psi.	0.43	11
Spherical— 15 psi.	0.75	3 & 11
Rundown	0.59	12
Oil-field stock	0.63	12
Redwood—2-in.	0.59	12
Redwood—3-in.	0.63	12
Cylindrical horizontal	0.54	3
Storage	0.44-0.72	3
Average	**0.58**	
Waste heat boilers	0.90	3

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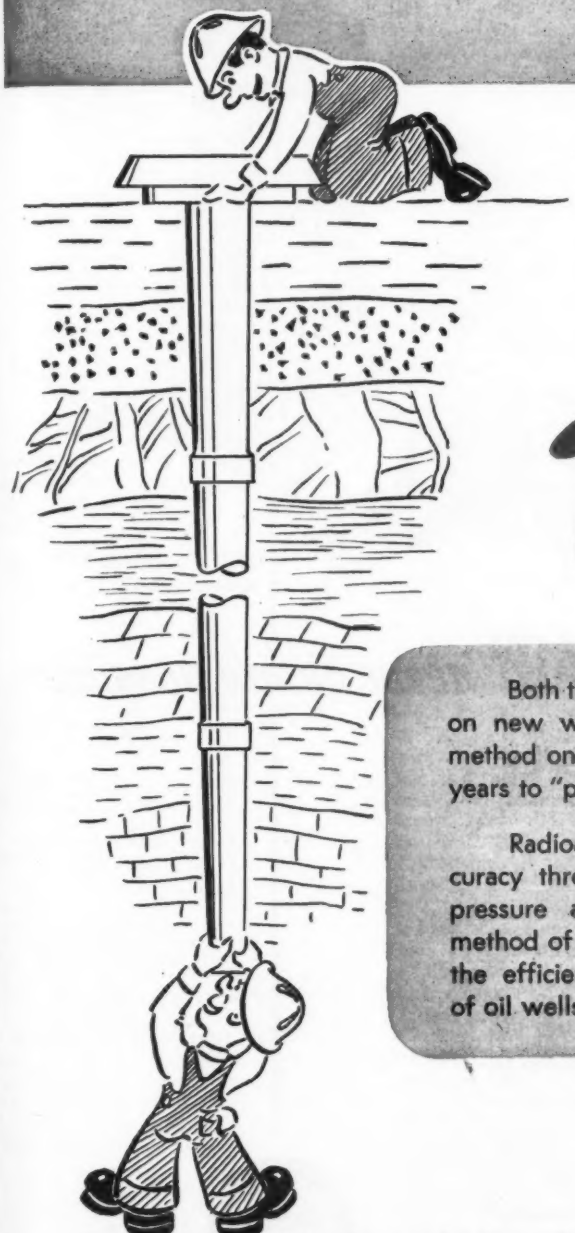
CURRENT ITEMIZED COST INDEXES

Indexes Based on 1946 = 100

	1947	1948	1949	March 1950	June 1950	References*	Complete index appears in Cost-imating
Labor:							
Skilled construction	112.0	125.0	133.9	137.2	139.8	Engineering News Record	No. 55—Nov. 3, 1949
Common labor	115.0	131.0	140.4	143.9	147.9	Engineering News Record	No. 55—Nov. 3, 1949
Refinery construction	113.5	128.0	137.1	140.5	143.9		
Refinery operation	109.0	126.0	132.9	‡131.9	†135.7	Survey of Current Business	No. 61—Dec. 15, 1949
Equipment or materials:							No. 55—Nov. 3, 1949
Board, insulation, 48-in.	112.5	125.0	125.1	124.9	129.2	Code 561	
Boiler tubes, 2¼ in.	115.0	†135.0	140.9	148.3	148.2	Code 409.2	
Brick and tile composite	114.0	137.0	131.4	132.8	133.6	Composite	No. 22—Mar. 17, 1949
Brick, common	110.5	127.0	133.1	133.5	136.7	Code 498.1	
Brick, fireclay	114.0	126.0	131.3	141.4	141.4	Code 499	
Building materials composite	135.5	153.0	145.8	146.3	152.4	Composite	No. 22—Mar. 17, 1949
Castings, gray iron	118.5	†139.5	†141.5	....	160.0	Code 416.7	No. 46—Sept. 1, 1949
Castings, pipe	129.0	†180.0	173.8	171.2	161.9	Code 434.2	No. 46—Sept. 1, 1949
Cement	111.0	125.0	128.2	129.6	129.6	Code 509.1	No. 22—Mar. 17, 1949
Compressor	114.0	128.0	120.0	117.0	117.0	Manufacturer	No. 36—June 23, 1949
Engines (composite)	109.0	120.0	115.5	113.2	113.2	Manufacturer	No. 36—June 23, 1949
Gas	111.0	122.0	117.0	115.0	115.0	Manufacturer	No. 36—June 23, 1949
Diesel	108.0	117.0	114.0	111.5	111.5	Manufacturer	No. 36—June 23, 1949
Exchangers	†115.0	†130.0	†133.0	....	....		No. 2—Oct. 28, 1948
Instruments (composite)	113.0	120.0	123.1	123.1	123.8	Manufacturer	No. 34—June 9, 1949
Flow meter, mechanical	102.0	....	109.2	109.2	109.2	Manufacturer	No. 34—June 9, 1949
Flow meter, air control	....	....	132.4	132.4	132.4	Manufacturer	No. 34—June 9, 1949
Flow meter, remote	....	....	130.2	130.2	130.2	Manufacturer	No. 34—June 9, 1949
Potentiometer, 6-pt.	111.0	....	125.8	130.0	130.0	Manufacturer	No. 34—June 9, 1949
Potentiometer, air control	....	....	131.6	131.6	131.6	Manufacturer	No. 34—June 9, 1949
Pressure controller	....	....	130.2	130.2	130.2	Manufacturer	No. 34—June 9, 1949
Pressure gage	109.0	....	100.0	100.0	100.0	Manufacturer	No. 34—June 9, 1949
Thermometer, recording	....	....	118.6	118.6	121.0	Manufacturer	No. 34—June 9, 1949
Control valve	117.0	....	129.8	129.8	129.8	Manufacturer	No. 34—June 9, 1949
Insulation, asbestos pipe	118.0	122.0	130.1	130.1	130.2	Code 767	
Lumber (composite)	155.0	175.0	160.1	165.9	180.9	Composite	No. 7—Dec. 2, 1948
Cypress, C grade	155.0	178.0	213.5	247.1	246.8	Code 529-2	
Pine, Ponderoso No. 3	140.0	176.0	159.0	158.8	173.5	Code 524-1	
Pine, yellow timbers	138.0	161.0	154.8	156.6	163.0	Code 522-9.1	No. 7—Dec. 2, 1948
Redwood, heart	134.0	†159.0	154.6	171.1	180.8	Code 528-3	
Motors, electric	110.0	112.7	114.0	129.0	129.0	Manufacturer	No. 31—May 19, 1949
Paint and paint materials	137.0	135.0	127.5	115.9	116.2	Composite	No. 22—Mar. 17, 1949
Paint, inside, flat	133.5	137.0	147.0	142.7	142.4	Code 531-1	
Paint, outside	150.0	†156.0	157.0	146.3	146.2	Code 532-1	
Pipe, sewer	111.5	121.5	119.1	121.6	131.8	Code 572.1	No. 22—Mar. 17, 1949
Pipe, black, ¾-in.	120.5	†148.0	152.2	158.8	158.8	Code 435.1	No. 42—Aug. 4, 1949
Pump (composite)	118.7	129.1	131.7	129.3	131.7	Manufacturer	No. 29—May 5, 1949
Centrifugal	109.0	120.0	118.9	119.0	123.7	Manufacturer	
Reciprocating	128.5	138.1	144.6	139.6	139.6	Manufacturer	
Sand	112.0	122.0	127.4	127.8	128.7	Code 579.2	
Steel (composite iron and steel)	121.0	140.5	150.2	153.0	153.4	Composite	No. 61—Dec. 15, 1949
Plate (tank)	117.5	†144.0	144.5	150.9	150.9	Code 446.3	No. 5—Nov. 18, 1948
Sheet, galvanized	105.0	†146.0	139.0	142.1	150.9	Code 448.3	
Structural	113.5	†145.0	151.3	161.8	161.8	Code 452.2	No. 18—Feb. 17, 1949
Transformers	116.0	116.0	116.0	116.0	98.7	Manufacturer	No. 31—May 19, 1949
Marshall-Stevens (equipment only) indexes:							
Process industries (average)	121.0	131.5	131.5	130.9	133.0	Chemical Engineering Aug. 1950	Chem. Eng., Feb. 1950
Chemical	119.5	130.0	130.0	129.2	131.0	Chemical Engineering Aug. 1950	Chem. Eng., Feb. 1950
Petroleum	121.0	132.0	132.0	131.4	133.6	Chemical Engineering Aug. 1950	Chem. Eng., Feb. 1950
Electrical power	122.0	135.0	135.0	134.4	136.5	Chemical Engineering Aug. 1950	Chem. Eng., Feb. 1950
Refrigeration	129.9	141.0	139.9	138.3	142.7	Chemical Engineering Aug. 1950	Chem. Eng., Feb. 1950
Steam power	122.0	132.0	132.0	131.2	133.4	Chemical Engineering Aug. 1950	Chem. Eng., Feb. 1950
Nelson—Refinery Construction	117.0	132.5	139.6	142.6	145.1		No. 61—Dec. 15, 1949

*The references for all codes, or for composite, is "Wholesale Prices" published monthly by the Bureau of Labor Statistics, U. S. Department of Commerce. †Estimate. ‡Revised.

FORESIGHT *or* HINDSIGHT



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Among the Drilling Contractors

Number of Active Rigs Highest in 2 Years

Rotary rigs operating in the United States and western Canada during the week ended September 25 (latest survey) totalled 2,336, the greatest number running at any time since the latter part of 1948, when the number of active rigs was at record high levels above 2,400.

The number represented an increase of 36 rigs as compared with active operations reported during the preceding week, and was 11 greater than 1950's previous highest number reported during the week ended August 14. Since the latter week, the number of active rigs has been above 2,300 consistently except for 2 weeks.

For the latest reported week, the number was 346 greater than for the corresponding week of 1949, and 11 more than at the same time 2 years ago.

ROTARY RIGS IN OPERATION*

(United States and Western Canada)

Area—	Week ended 9-25-50	Change week ended 9-18-50	Change week ended 9-26-49
Gulf Coast	523	+13	+ 13
W. Tex.-N. M.	758	+12	+197
Ark.-N. La.-E. Tex.	148	+ 5	— 3
Oklahoma	268	+ 5	+ 46
Kansas	†138	—13	+ 16
Illinois-Eastern	131	+ 9	+ 31
Rocky Mountains	123	+ 2	+ 18
Pacific Coast	143	0	— 11
Total United States	2,232	+33	+307
Western Canada	104	+ 3	+ 39
Total	2,336	+36	+346

*Courtesy Hughes Tool Co. Trends in drilling activity in the United States and the Pacific Coast and Illinois-Eastern areas are shown by charts on pages 304 and 305.
†Includes 8 rigs in Nebraska and 1 in Iowa.

Drilling & Exploration Co., Dallas, will drill a 10,500-ft. Ellenburger wildcat for R. J. Caraway in northeastern Val Verde County, Texas. The proposed test is to be 1 Guida Rose, CSE Section 2-GC&SF Survey.

N. V. Duncan, Oklahoma City, has a rig running for Kingwood Oil Co. in the West Morvin pool, Pottawatomie County, Oklahoma. Currently, it is on 2 Rader, NE NW NE 6-8n-3e.

Loffland Brothers Co., Tulsa, has the contract for a projected 8,200-ft. test being started by Thomas W. Doswell and T. E. Pettigrew in the NE NE 59-2-H&TC Survey, 7 miles east and slightly south of Snyder, Scurry County, West Texas. This contractor also has just taken an 8,500-ft. contract for a well to be drilled for Continental Oil Co. in the Table Mesa area, San Juan County, New Mexico. The latter test is 17 Unit in the SE SE SW 3-27n-17w.

Fleet Acquires Six Rigs From Sun Drilling Co.

Fleet Drilling & Production Co., Ada, Okla., and Dallas, has purchased six drilling rigs from Sun Drilling Co., Wilson, Okla. With the purchase, this company now has 17 rigs, including light, medium and heavy equipment. Sun Drilling Co. has retained two rigs, which it will use in developing some of its own properties in southern Oklahoma.

The Ada and Dallas company is headed by John J. Fleet of Dallas as president, and J. R. MacDonald, executive vice president, Tulsa. Sun is owned by R. M. Laurence and J. F. Stephenson, both of Wilson.

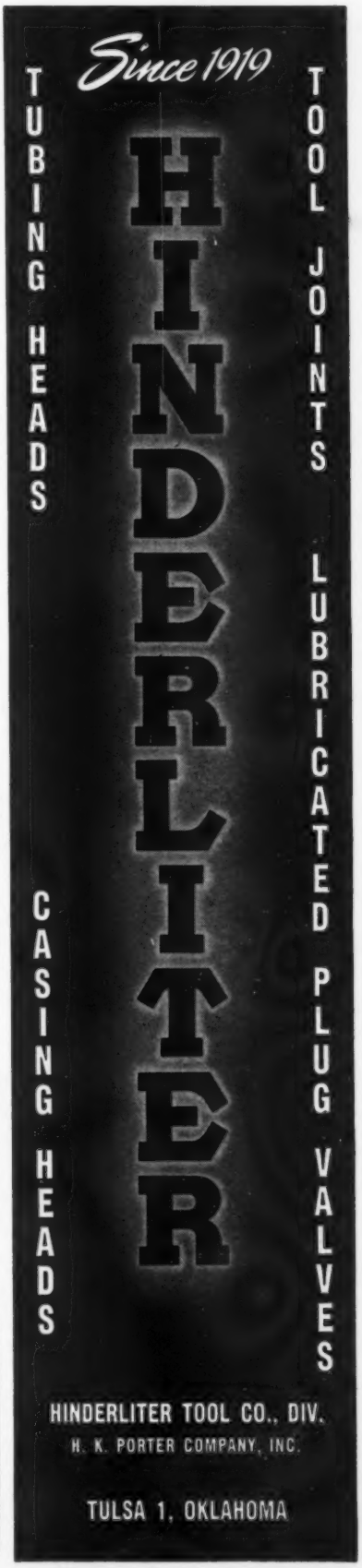
Fitch Drilling Co., Monahans, Tex., has contracted for a 4,000-ft. wildcat to be drilled for Geochemical Surveys, Inc., at 1-A W. H. Echols, in Section 45-33, H&TC Survey, 2½ miles west of Barstow, Ward County, West Texas.

Morton Drilling Co., Casper, Wyo., has contracted for a 3,500-ft. test to be drilled for Weller & Bush of Tulsa near Deadwood, Lawrence County, South Dakota. Location for the test, 1 Weisman, is in the NW SW SE 30-7n-4e.

McAlester Fuel Co., Magnolia, Ark., has contracted for two additional wells to be drilled by **C. H. Murphy** and associates in the recently opened Tubal field, on the Columbia-Union County line, in Arkansas. One, 1 Longing, C NW SW 28-19s-18w, will be a southeast offset to the discovery well. The other, 1 Owen, C NW NE 33, is about ¾ mile southeast. The discovery well, C. H. Murphy & Co. 1 Concannon, produces from the Smackover zone around 9,285 ft. and the Cotton Valley sand around 8,025 ft.

Summit Drilling Corp., Tulsa, has moved a rig into the North Antioch area, Garvin County, where it will drill for Deep Rock Oil Corp. at 1 Kahn-Hamilton, SE SE SE 11-3n-2w. Contract is for 5,800 ft.

C. E. Hall, Wichita Falls, Tex., has a rig running for An-Son Petroleum Co. in the Haws field, Mon-



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tague County, North Texas. Current operation is 1 Batendorf, S. Davidson Survey.

Drilling Firm Moves

Offices of Lowell-Voltz, Inc., Colorado drilling contracting firm, have been moved from Colorado Springs to Denver. J. R. Lowell, Jr., and M. R. Voltz are owners.

Clyde Hall Drilling Co., Bakersfield, Calif., is drilling Pacific Oil & Gas Development Corp. 62-A Glide, a wildcat test in 13-27s-27e, Poso-Creek-McVan area, Kern County, California.

Honaker Drilling Co., Great Bend, Kans., is moving a rig to Frontier County, Nebraska, where it has a contract for a 3,250-ft., or Dakota series, test for Indianola Oil Co. of Greeley, Colo. Location of the test is in 4-6n-28w, near Stockville.

Justiss-Mears Oil Co., Jena, La., has taken a contract for a 3,600-ft. test to be drilled for Shelton Development Co. in 13-20n-8e, 5 miles southeast of Bonita, West Carroll Parish, Louisiana.

McCutchin Drilling Co., Dallas, has the contract for the second well to be drilled in the recently opened Oil Creek sand pool east of Sandusky, northwestern Grayson County, Texas. The new test, 1 Marshall, an east offset to the discovery well, will be drilled for L. O. McMillan and associates, who discovered the pool. Location is in the B. Scarborough Survey.

Service Drilling Co., Tulsa, has moved a rig to Cimarron County, Oklahoma Panhandle, where it will drill a 5,000-ft. wildcat test for Gilchrist & Brumme of Tulsa. Location of the test is in the NE NE NE 14-4n-3eCM, between Boise City and Kenton.

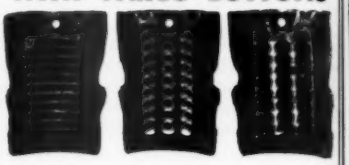
Rocky Mountain Drilling Co., Los Angeles, has drilling under way on a wildcat location in the Timber Canyon area, Ventura County, California. The location, 1 West, 13-4n-21w, is being drilled under contract for Richfield Oil Corp.

Rex Drilling Co., Shreveport, has started a deep, exploratory test for Jones-O'Brien Oil Co. and associates in the Tinsley field, Yazoo County, Mississippi. Location is on the Logan lease in 23-10n-3w.

Frontier Drilling Co., Denver, has been given the contract for the wildcat test which Tom Nix and Jess Harris of Oklahoma City have projected for the Darby Creek area in Logan County, Colorado. The test, located in the C SE NE 27-10n-53w, is expected to go to 5,500 ft.

VARCO

CASING SPIDER — AND ELEVATOR SEGMENTS WITH 'VARCO' BUTTONS



"Varco" buttons, popular for years in rotary drill pipe slips, proved satisfactory and have been adopted and are installed in segments of automatic casing spiders and elevators of various makes. Wickers are removed and holes bored for a maximum number of VARCO casing buttons, to assure uniform and maximum gripping area. Converting buttons for the next smaller casings are available. Write for complete descriptive data.

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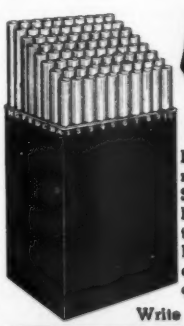
For the easiest brake known. It feeds off evenly. Standco never scores brake rims. See pages 3608-3613, Composite Catalog.
Standco Brake Lining Co.
HOUSTON



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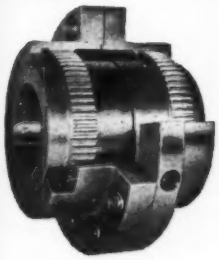

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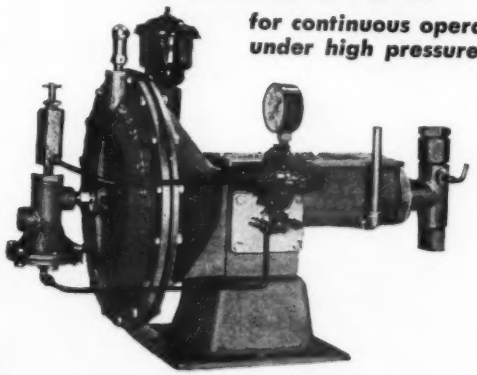

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Housing is of high tensile aluminum alloy; injector head has Stellite pistons and valves. Full information furnished upon request.

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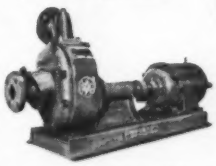
MARLOW SELF-PRIMING CENTRIFUGAL PUMPS

These efficient, high capacity pumps prime and reprime automatically. Positively self-cleaning; do not jam or clog. Extra heavy construction. Used to supply water, condition mud, dewater, transfer oil from tanks, circulate tank bottoms, salvage oil, wash down equipment, and do many more jobs. Engine driven: Sizes 1½ to 10 inches, 15 to 3500 GPM. Available base mounted, with steel wheels or rubber tired wheels. Electric motor driven: Sizes 1½ to 10 inches, 15 to 3300 GPM, 1/3 to 50 hp., close coupled or long coupled.

A typical Marlow Self-Priming Centrifugal engine driven model for portable applications.



An electric motor driven Marlow . . . . ideal for stationary installations.

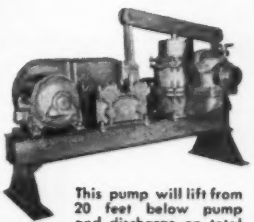
MARLOW MUD HOG DIAPHRAGM PUMPS

Powerful lift and force pumps for the heavy messy wastes that a centrifugal can't handle. Patented ball valve chambers are virtually clog-proof. Dependable for heavy duty dewatering, cleaning tank bottoms and cooling towers, for conditioning drilling mud, feeding slush pump, transferring water from wash pits and many other oil country tasks. Sizes 3- and 4-inch single and 4-inch double; 50, 100 and 150 GPM. Gasoline engine or electric motor driven. Skid base or steel or pneumatic wheels.

A Marlow "Mud Hog" Diaphragm Pump will take a trickle or full capacity at each stroke.

MARLOW WALKING BEAM PLUNGER PUMPS

The rugged Marlow walking Plunger Pump is fitted with metal plunger instead of diaphragm. With same basic features as the diaphragm pump, well suited to indefinitely sustained pumping for removing heavy sludge, residues, recirculation, for tank bottom disposal and other heavy jobs. Sizes 3- and 4-inch single; 60 to 90 GPM. Gasoline engine or electric driven, portable or stationary mounting.



This pump will lift from 20 feet below pump and discharge on total heads of up to 80 feet.

Steam turbine drives available for all three types—Self-Priming Centrifugal, Diaphragm and Plunger Pumps.

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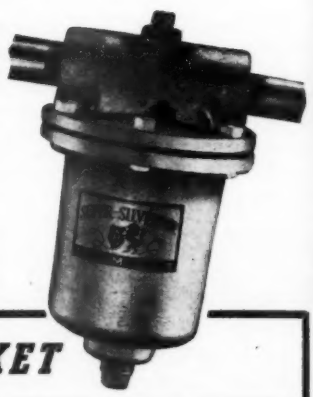

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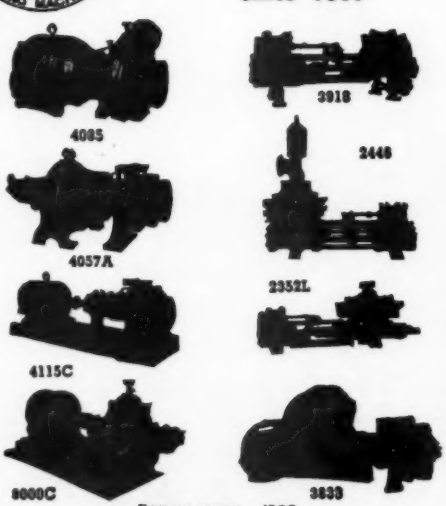

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PIPE LINES

Basin System Expansion

HOUSTON. — The major development of new reef oil fields in Scurry, Borden, Dawson, and Kent counties on the east side of the Permian basin in West Texas was responsible for the recent expansion program announced for the Basin Pipe Line System, according to R. B. McLaughlin, Houston, president of Texas Pipe Line Co., which operates the system.

It was in this area that the Railroad Commission of Texas issued an emergency order during September reducing daily production by 61,860 bbl. and fixed an October daily allowable 79,000 bbl. less than that effective prior to the issuance of the emergency order. The lack of pipe line and storage facilities were contributory reasons for the cut.

During the month of September, an average of 115,000 bbl. of oil daily was being received by the Colorado City station of the Basin system, McLaughlin said. Colorado City is located on Segment 1 of the system which extends from Jal, N. M., to Wichita Falls, Tex.

The pipe-line president said that four 6,000-hp. pumping stations will be constructed between Colorado City and Cushing, Okla. Additional storage facilities would include eight 122,700-bbl. tanks to be constructed at Colorado City and two 122,700-bbl. tanks to be erected at Wichita Falls. At Cushing, oil is tendered to the connecting carriers by pipe line including Ozark Pipe Line System, which operates a 22-in. line to Patoka, Illinois.

On Ozark's system, five new pump stations have been announced for early construction. With modification of existing stations, the new installations will increase the daily capacity approximately 68,000 bbl.

The new stations will be located near Wildhorse and Fairland, Okla., and Lawrenceburg, Swedeborg and Labadie, Mo. Their construction is set for completion to handle the increased flow from Basin's new improvements. Present daily capacity is 207,000 bbl.

Interprovincial Section

The Regina, Sask. - Gretna, Man., section of the Interprovincial Pipe Line Co. project was completed on September 19 by Williams Brothers Corp. This section is now ready for receiving crude oil. It consists of 308 miles of 16-in. and 34 miles of 18-in., totaling 343 miles. The final weld was made between Glenboro and Souris, Manitoba.

Price Crews in Field

Three field crews of H. C. Price Co. have started laying a 309-mile span of the new Texas Illinois Natural Gas Pipeline Co.'s transmission system between Hungerford, Tex., and Texarkana. Less than 1 month ago announcement was made that Price would participate in construction of the $120,000,000 Corpus Christi-to-Joliet natural gas artery.

In addition to the 30-in. installation, Price is responsible for 97 miles

Backfilling close behind lowering-in operations of an H. C. Price Co. spread engaged in building the extension to Buffalo, N. Y., for Tennessee Gas Transmission Co.

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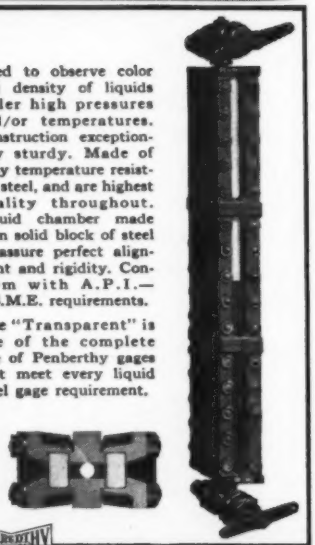
The "Transparent" is one of the complete line of Penberthy gages that meet every liquid level gage requirement.



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of 26-in. feeder line from LaGloria field near Corpus Christi; 36 miles of 24-in. extension to the Old Ocean field; and 38 miles of 12-in. supply line into the Chocolate Bayou field near Galveston. The firm will also handle the multiple-line crossing of Trinity River north of Houston.

Pipe-line construction on the Texas Illinois line will total $35,000,000. Sharing with Price in this outlay are Bechtel Corp. and Midwestern Constructors, Inc. Bechtel's contract calls for 420 miles of 30-in. line in Arkansas and Missouri with several river crossings, and Midwestern will lay 100 miles of 26-in. line in the coastal plains area of Texas, and 292 miles of 30-in. line from Cape Girardeau, Mo., to Joliet, Ill.

All of the 30-in. pipe is being fabricated at the new $5,000,000 plant of A. O. Smith Corp., Houston.

Crude, Products Flow Up

WASHINGTON.—The 50 largest petroleum pipe-line companies reporting to the Interstate Commerce Commission moved 632,263,177 bbl. of crude and products during the June quarter and had transportation revenues of $96,263,570, it is shown by a tabulation just compiled by ICC.

Volume showed an increase of more than 50,000,000 bbl. over the 580,979,736 bbl. reported for the corresponding 1949 quarter, and revenue was 14.5 per cent above the $84,059,821 received last year.

The largest movement over any system was 54,969,510 bbl. reported by Humble Pipe Line Co., which had a transportation revenue of $7,196,213. The largest revenue was $11,708,175 reported by Service Pipe Line Co. (formerly Stanolind), from the movement of 36,871,457 bbl.

More than half the total volume reported by the 50 companies was moved by nine who each reported more than 30,000,000 bbl. In addition to the Humble and Service lines, the list included: Buckeye Pipe Line Co., 39,428,478 bbl.; Gulf Refining Co., 36,480,008 bbl.; Interstate Oil Pipe Line Co., 40,876,647 bbl.; Magnolia Pipe Line Co., 36,095,562 bbl.; Ohio Oil Co., 32,031,993 bbl.; Sinclair Refining Co., 31,583,251 bbl.; and Texas Pipe Line Co., 33,060,240 bbl.

Winter Service Assured

HOUSTON.—Thanksgiving Day dinners in western New York can be cooked with natural gas supplied by Tennessee Gas Transmission Co.'s new pipe-line system, according to an announcement by N. W. Freeman, vice president.

Mains of East Ohio Gas Co. have begun filling and immediate deliveries are scheduled to Equitable Gas Co., United Natural Gas Co., Manufacturers Light & Heat Co., and Peoples Natural Gas Co., supplying Ohio and Pennsylvania communities.

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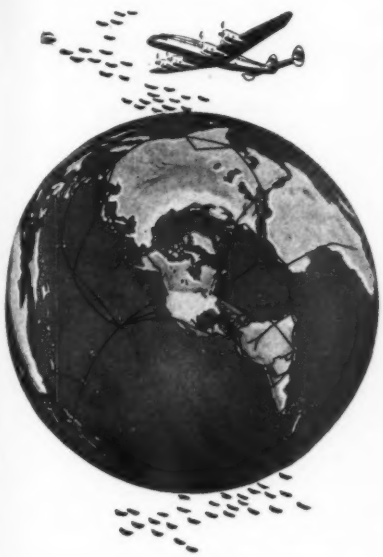

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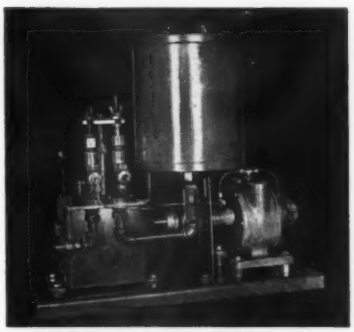
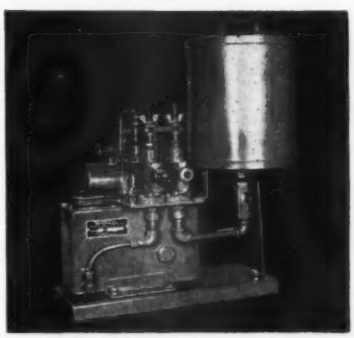
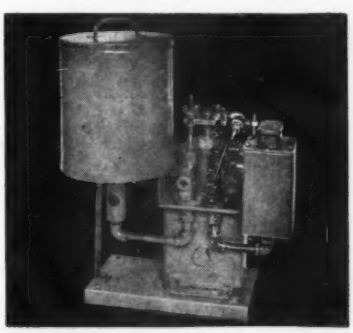


Self Lubricating Manzel Feeder with Rotary Drive Motor



Self Lubricating Manzel Feeder with Reciprocating Drive Motor



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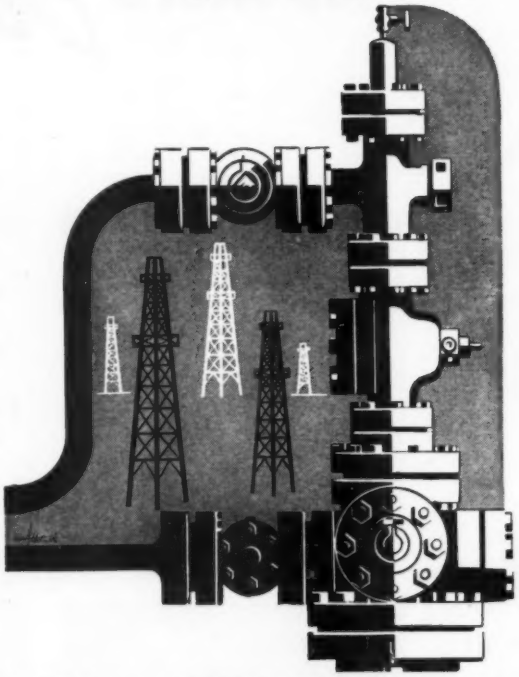

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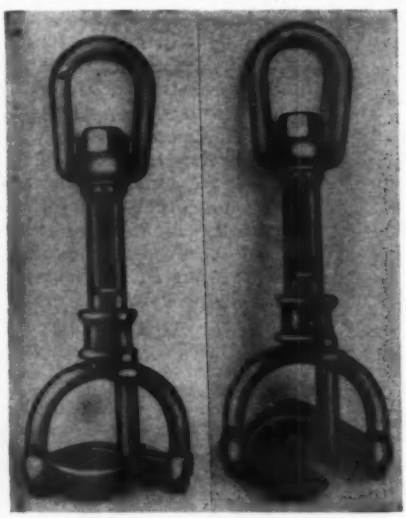

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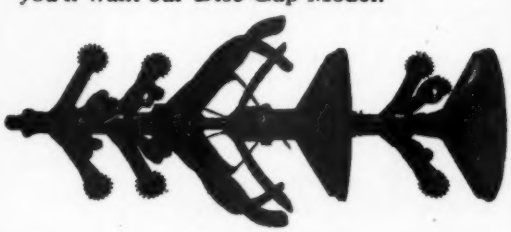

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Pipe-Line Construction

FOLLOWING is a tabulation of pipeline projects which are planned or under construction. Included are crude-oil, products, and natural-gas lines. The list was compiled from surveys made by The Oil and Gas Journal.

Crude-Oil Pipe Lines

Gulf Refining Co., Tulsa Pipe Line Division.—72 miles, 6-in., under way, El Dorado, Kans., to Webb City, Okla.; Pipeline Service Co., contractor. J. W. Welcher, Atlanta, Kans., spreadman.

Lakehead Pipe Line Co., Inc. (American subsidiary of Interprovincial Pipe Line Co., Canada).—321 miles, 18-in., contracted Neche, N. D., to Superior, Wis., to be completed October 1950; Anderson Bros., contractor.

Pan American Pipe Line Co.—80 miles, 10-in., under way, from southern part of Scurry County, Texas, to a connection with Humble pipe line near San Angelo, Tex.; Brown & Root, contractor.

Pelican Oil Co.—60 miles, 6-in., under way, Lake Charles to DeQuincy, La.

Phillips Pipe Line Co.—50 miles, 6-8-in., under way, Phillips tank farm, Sweeny, Tex., to Humble's Webster Station, Galveston County, Texas; O. R. Burden Construction Co., contractor; B. C. Barney Hall, spreadman.

Phillips Pipe Line Co.—25 miles, 8-in., considered, loops between Thrall and Kansas City, Kans.

Platte Pipe Line Co.—1,080 miles, 16-20-in., planned, Worland, Wyo., to Wood River refining area in Illinois.

Platte Pipe Line Co.—940 miles, 20-in., planned, Casper to Wood River.

Platte Pipe Line Co.—140 miles, 16-in., planned, Worland to Casper, Wyo.

Portland Pipe Line Co. (Montreal Pipe Line Co., Ltd.).—236 miles, 18-in., contracted, Portland, Me., to Montreal, Que., Canada.

Portland Pipe Line Co. (Montreal Pipe Line Co., Ltd.).—85 miles, 18-in., under way, Portland, Me., to Gorham, N. H.; Oklahoma Contracting Co., contractor of Section 1; H. A. Waylie, Westbrook, Me., superintendent.

Portland Pipe Line Co. (Montreal Pipe (Canada).—321 miles, 18-in., contracted, Gorham, N. H., to international boundary near N. Troy, Vt.; Associated Pipeline Contractors, Inc., contractor of Section 2. Lacy Walker, Barton, Vt., spreadman.

Portland Pipe Line Co. (Montreal Pipe Line Co.).—68 miles, 18-in., contracted, Canadian boundary to Montreal; Fred Mannix, contractor of Section 3.

Service Pipe Line Co.—25 miles, 8-in., under way, Beaver Creek and Riverton, Wyo.; Vaughn & Taylor Construction Co.

Shell Pipe Line Corp.—39 miles, 10-in., under way, McCamey to Kemper, Tex.; McVean & Roberts, contractor.

Socony-Vacuum Oil Co., Inc. (White Eagle Division).—122 miles, 8-in., considered, Big Horn basin to Casper, Wyo.

Texas-New Mexico Pipe Line Co.—16½ miles, 10-in., under way, Scurry County, Texas; O. R. Burden, contractor, Bill Price, spreadman.

West Coast Pipe Line Co.—20-in., planned, Permian basin, West Texas, to California.

Products Pipe Lines

Great Lakes Pipe Line Co.—39 miles, 12-in., under way, Hawarden, Iowa, to Sioux Falls, S. D.; Midwestern Constructors, Inc., contractor, R. C. Stanley, Canton, S. D.

Great Lakes Pipe Line Co.—355 miles, 12-in., authorized, Kansas City through Omaha and Sioux City, Iowa, to Sioux Falls, S. D.

Phillips Petroleum Co.—281 miles, 10-in., proposed, Borger, Tex., to Yale, Okla.

Phillips Petroleum Co. and Shamrock Oil & Gas Co.—155 miles, 6-in., planned, extension on 600-mile line at Phillips, Tex., via La Junta, to Denver.

Pure Transportation Co.—100 miles, 6-in., proposed, Heath to Dayton, Ohio.

Salt Lake Pipe Line Co.—242 miles, 6-8-in., under way, Boise, Idaho, to Pasco, Wash. Completion date, December 1950.

Salt Lake Pipe Line Co.—140 miles, 8-in., contracted Boise, to Baker, Idaho; Bechtel Corp., contractor.

Salt Lake Pipe Line Co.—Contracted, Macco Corp., and Morrison-Knudson Co., Inc.

Salt Lake Pipe Line Co.—120 miles, 6-8-in., under way, Baker, Ore., to Pasco, Wash. Completed August 8, 1950; Pacific Pipeline & Engineers, Ltd., contractor, L. E. Robertson, LaGrande, Ore., spreadman.

Standard Oil Co. (Ohio) and Shell Oil Co.—56 miles, 8-in., under way, Lima to Springfield, Ohio; Tulsa Construction Co., contractor.

Susquehanna Pipe Line Co.—126 miles, 8⅝-in., under way, Toledo, Ohio, to Sarnia, Ont., Canada; H. L. Gentry Construction Co., contractor. James Mitchell, Toledo, Ohio, spreadman.

Natural-Gas Pipe Lines

Acme Natural Gas Co.—25½ miles, 10-in., contracted, Ellwood to Butler, Pa., to be completed December 15, 1950; Williams-Austin Co., contractor. Howard Bauer, Zelienople, Pa., spreadman.

Alabama-Tennessee Natural Gas Co.—35 miles, 8-in., authorized, Muscle Shoals to Decatur, Ala.

Algonquin Gas Transmission Co.—276 miles, proposed, Lambertville, N. J., to Boston area.

Algonquin Gas Transmission Co.—492 miles, proposed, laterals, New England area.

Atlantic Gulf Gas Co. (United Gas Pipe Line Co.).—1,530 miles, planned, Alabama-Florida-Georgia-South Carolina.

Central Kentucky Natural Gas Co.—42 miles, 20-in., under way, North Means compressor station to Foster, Ky; completion date December 15, 1950; Williams-Austin Co., contractor, Leman Creech, Mt. Sterling, Ky., spreadman.

Chicago District Pipe Line Co.—41 miles, 24-in., authorized, loop Calumet pipe line—Joliet, Ill., to Chicago, completion date December 1950.

City of Indianapolis, Inc.—22 miles, 16-in., proposed, Indianapolis to Panhandle Eastern Corp.

Coast Counties Gas & Electric Co.—40 miles, 3-4-8-in., considered, coast and valley region, California.

Coastal Pipe Line Co.—1,000 miles, planned, Texas to Norfolk, Va.

Commonwealth Natural Gas Corp.—84 miles, 12-in., contracted, Richmond to Newport News, Va.; Ray L. Smith, contractor.

Commonwealth Natural Gas Co.—20 miles, 8-in., contracted, James River to Newport News, Va.; Ray L. Smith, contractor.

Commonwealth Natural Gas Corp.—104 miles, 18-in., under way, Standardsville to near Petersburg, Va.; Ray L. Smith & Son, contractor, Don C. Smith, Orange, Va., spreadman.

Commonwealth Natural Gas Corp.—537 miles, 20-in., proposed, West Bend, Ky., to Norfolk, Va.

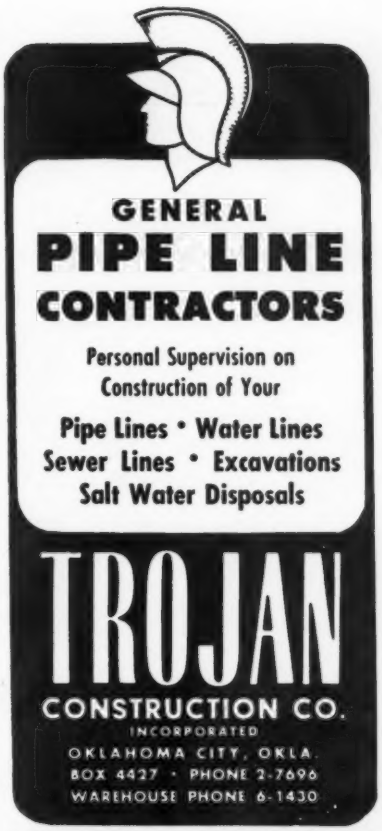
Consolidated Gas Utilities Corp.—41 miles, 12-in., planned, Enid to Blackwell, Okla., Marlow to Cement, Okla.

East Ohio Gas Co.—24 miles, 20-in., authorized, northeastern Ohio to near Petersburg to East Ohio's Austintown station near Youngstown.

East Tennessee Natural Gas Co.—100 miles, planned, lateral to be laid in 1950.

East Tennessee Gas Corp.—150 miles, 16-in., under way, Knoxville to Bristol, Tenn.

East Tennessee Natural Gas Co.—398 miles,



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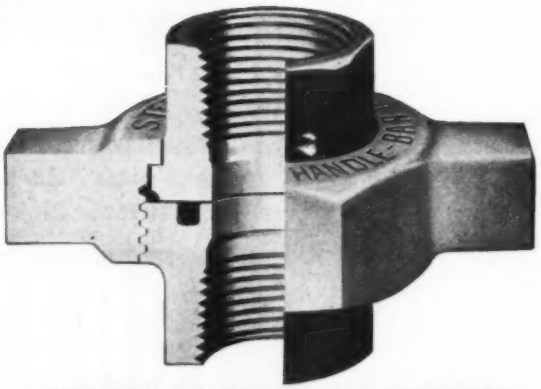

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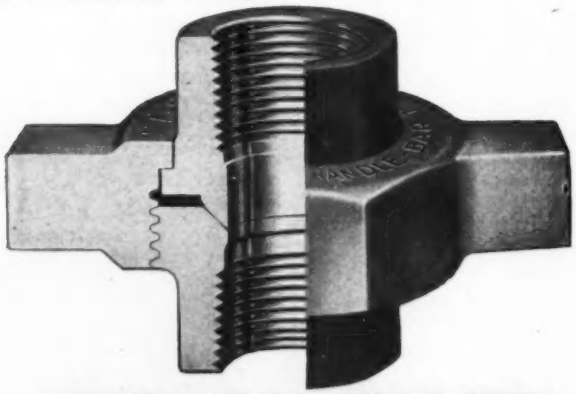

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East Tennessee Natural Gas Co.—130 miles, 12-in., under way, Athens, via Chattanooga, to Tullahoma, Tenn.; N. A. Saigh Co., Inc.

East Tennessee Natural Gas Co.—120 miles, 12-in., planned, Chattanooga to Knoxville, Tenn.; Walters & Saigh Construction Co.

East Tennessee Natural Gas Co.—185 miles, 16-in., planned, Lobelville to Chattanooga, Tenn., Walters & Saigh Construction Co.

Eastern Natural Gas Corp.—292 miles, 24-in., proposed, Phoenixville, Pa., via New Haven and Hartford, Conn., Providence, R. I., Springfield, Mass., and Boston.

Egyptian Natural Gas Co.—80 miles, 6-8-in., planned, Norris City to Salem-Centralia, Ill., area.

El Paso Natural Gas Co.—352 miles, 30-in., under way, looping of 26-in., New Mexico-California line and connection with Pacific Gas & Electric Co. at Needles, Calif., to be completed November 1950.

El Paso Natural Gas Co.—450 miles, 24-in., authorized, San Juan basin, New Mexico, to Franconia, Ariz., to be completed November 1951 by company crews.

Home Gas Co.—70 miles, planned, Orange, Sullivan, Rockland, and Cattaraugus counties, New York.

Jersey Central Power & Light Co.—39 miles, 10-in., planned, New Jersey coast system of Texas Eastern Transmission Co.'s Big Inch.

Magnolia Petroleum Co.—60 miles, 4-24-in., gathering system in LaWard and Lolita fields, Texas; Henry L. Lemons & Co., contractor. W. A. Remington, spreadman.

Michigan Gas Storage Co.—150 miles, 20-in., planned, Chelsea terminal-Winterfield and Cranberry Lake, Mich.; Mahoney Contracting Co., contractor.

Michigan-Wisconsin Pipe Line Co.—197 miles, 6-18-in., under way, Milwaukee to Green Bay and Two Rivers, Wis.; G. G. Griffis Construction Co., contractor. F. K. Egan, Fond du Lac, Wis.

Mississippi River Fuel Corp.—40 miles, 18-in., authorized, Dubach to Perryville, La.

Montana-Dakota Utilities Co. and Montana-Wyoming Gas Pipe Line Co.—335 miles, 12¾-in., under way, Worland, Wyo., to Baker, Mont.; R. A. Conyes Construction Corp., contractor. Al Poggi, Hardin, Mont., superintendent.

New York State Natural Gas Corp.—42 miles, 20-in., Ohio-Pennsylvania line to Bakerstown, Pa.; Tulsa-Williams Co., contractor. O. L. Martin, Darlington, Pa., spreadman.

New York State Natural Gas Corp.—21 miles, 20-in., under way, Tonkin station to Bakerstown, Pa., to be completed December 1, 1950; Williams-Austin Co., contractor. Ralph Gaddy, New Kensington, Pa., spreadman.

New York State Natural.—164 miles, 16-in., planned, Ithaca to Albany, N. Y.

New York State Natural Gas Corp.—70 miles, 20-in., planned, North Oakford, Pa., to Ohio state line.

Niagara Mohawk Power Corp.—35½ miles, 10-14-in., under way, Therm station, to Fulton, N. Y.; Williams-Austin Co., contractor. Howard Bauer, Nedrow, N. Y., spreadman.

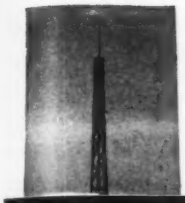
Northeastern Gas Transmission Co.—511 miles, up to 20-in., proposed, to extend from a connection with a proposed Tennessee Gas Transmission Co. extension to serve New England states.

Northern Natural Gas Co.—597 miles, 20-26-in., contracted, ten loops from Texas to northern Iowa.

Northern Natural Gas Co.—76 miles, 4 to 12-in., under way, gathering line in vicinity of Hugoton, Kans., Cheek Construction Co., contractor, Troy Cheek, Ulysses, Kans., superintendent.

Northern Natural Gas Co.—111 miles, 24-in., under way, Ogden, Iowa, to St. Paul, Minn.; R. B. Potashnick, contractor.

Northern Natural Gas Co.—75 miles, 26-in., under way, north of Beaver, Okla.; R. H. Fulton & Co., contractor of Loop 2. Merele Lewellen, Mead, Kans., spreadman.



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Northern Natural Gas Co.—33 miles, 26-in., contracted, Mullinville, Kans., station; R. H. Fulton & Co., contractor of Loop 3.

Northern Natural Gas Co.—72½ miles. 26-in., under way, Bushton to Minneapolis, Kans.; R. H. Fulton & Co., contractor of Loop 4. M. L. Boyd, Salina, Kans., spreadman.

Northern Natural Gas Co.—155 miles, 20-in., contracted, Garden City to Bushton, Kans.; R. H. Fulton & Co., contractor of Loop 5. Jerry Nash, Garden City, Kans., spreadman.

Northern Natural Gas Co.—43 miles, 26-in., under way, Palmyra, Neb., station to Oakland, Iowa, station; Midwestern Construction Co., Inc., contractor of Loop 6. R C. Stanley, Glenwood, Iowa, spreadman.

Northern Natural Gas Co.—65 miles, 26-in., under way, northeastward from Oakland, Iowa, station; Midwestern Construction, Inc., contractor of Loop 7. Lyle S. DeWitt, Palmyra, Neb., and J. A. Bard, Beatrice, Neb., superintendent.

Northern Natural Gas Co.—31 miles, 26-in., under way, north of Ogden, Iowa; R. B. Potashnick Co., contractor of Loop 8. H. F. Carr, Ventura, Iowa, spreadman.

Northern Natural Gas Co.—41 miles, 26-in., contracted, northward from Ventura, Iowa, station; R. B. Potashnick Co., contractor of Loop 9.

Northern Natural Gas Co.—40 miles, 26-in., contracted, Ventura, Iowa, station; R. B. Potashnick, contractor of Loop 10.

Northern Natural Gas Co.—222 miles, 26-in., under way, Borger, Tex., to Nebraska line; R. H. Fulton & Co., contractor. M. C. Boyd, Ashland, Kans., spreadman.

Northwest Natural Gas Co.—750 miles, planned, Washington, Oregon, and Idaho.

Ohio Fuel Gas Co.—22 miles, 16-in., authorized, Dayton, Troy, Piqua, and Sidney, Ohio.

Pacific Gas & Electric Co.—47 miles, 8-in., authorized, Salinas to Kilig City, Calif

Pacific Gas & Electric Co.—506 miles, 31-in., under way, Topock, Ariz., to Llanda, Calif.; Bechtel-Price-Conyes Corp., contractor. R. L. Bowman, general superintendent.

Pacific Lighting Corp.—23 miles, 30-in., planned, Inglewood to Encino, Calif.

Pacific Lighting Corp.—41 miles, 30-in., planned, Puente to March Field, California, to be completed 1950.

Pacific Northwest Pipe Line Co.—400 miles, 22-in., gathering lines on Texas Gulf Coast to Pacific Northwest pipe line.

Pacific Northwest Pipe Line Corp.—2,175 miles, 26-in., authorized, Texas Gulf Coast to Pacific Northwest.

Panhandle Eastern Pipe Line Co.—356 miles, 26-in., authorized, looping in Texas, Oklahoma, Kansas, Missouri, Illinois, Indiana, Ohio, and Michigan.

Phillips Petroleum Co.—118 miles, 3-22-in., under way, Sherman and Hansford counties, Texas, gas-gathering system; Vaughn & Taylor Construction Co., Inc., Texhoma, Okla.

Piedmont Natural Gas Co.—1,350 miles, 20-in., planned, Greenville, Miss., to Carolinas.

Plains Natural Gas Co.—120 miles, 4-24-in., contracted, Oklahoma-Kansas area, Hugoton field, gathering system; Midwestern Constructors, Inc., (Arey-Phillips Construction Co.) contractor. T. S. Nunley, Liberal, Kans., spreadman.

Potomac Gas Co.—18 miles, 16-in., planned, Dranesville to Arlington, Va.

Prince George's Gas Corp.—20 miles, 22-in., authorized between Chillum and Rockville, Md.

Roanoke Pipe Line Co.—30 miles, 8-in., authorized, Gala, Va., to Roanoke.

San Diego Gas & Electric Co.—53 miles, 16-in., planned, San Diego County, California.

San Diego Gas & Electric Corp. (Southern Counties Gas Co.)—85 miles, authorized, San Diego, Riverside, and Moreno, California.

South Central Alabama Natural Gas Co., Inc.—150 miles, proposed, central Alabama.

South Georgia Natural Gas Co.—248 miles, planned.

South Jersey Gas Co.—75 miles, 10-12-14-in., under way, Pleasantville, N. J., to

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MERCANTILE BANK BUILDING
DALLAS, TEXAS

COMMERCE BUILDING
HOUSTON, TEXAS

Bustleton, Pa.; G. G. Griffis, Inc., contractor, Ray Abney, Millville, N. J., spreadman

South Jersey Gas Co.—14-in., under way, Franklinville to Bridgeton, N. J.; G. G. Griffis, Inc., contractor.

Southwestern Michigan Gas Co.—55 miles, 12¾-in., proposed, Oakland County to Marysville, Mich.

Southern California Gas Co.—83 miles, 30-in., under way, Whitewater, Riverside County, to Puente, Los Angeles County, California; Midwestern Constructors, joint contract with Johnson Western Gunite—L. E. Dixon. John Work, Banning, Calif., superintendent.

Southern Counties Gas Co. of California.—81 miles, 20-in., authorized, looping.

Southern Natural Gas Co.—32 miles, 16-in., under way, Wetumpka to Tallassee, Ala.; completion due November 1; Sheehan Pipe Line Construction Co., contractor, C. M. Brown, spreadman.

Southern Natural Gas Co.—180 miles, 18-in., under way, Gwinville, Miss., to Selma, Ala.; Sheehan Pipe Line Construction Co., contractor. Jim Brown, Meridian, Miss., spreadman.

Southern Natural Gas Co.—24 miles, 24-in., under way, loops to Mississippi, Alabama, Georgia; Sheehan Pipe Line Construction Co., contractor. Jim Brown, R. H. Brown, spreadmen.

Southern Natural Gas Co.—95 miles, 18-in., under way, Gwinville to Mississippi-Alabama state line; completion due November 1; Sheehan Pipe Line Construction Co., contractor. J. W. Brown, spreadman.

Southern Natural Gas Co.—85 miles, 18-in., under way, Mississippi-Alabama state line to Selma, Ala.; completion due November 1; Sheehan Pipe Line Co., contractor. C. M. Brown, spreadman.

Southern Natural Gas Co.—110 miles, 11-in., considered, extension.

Southern Natural Gas Co.—118 miles, 13-in., planned, extension.

Southern Natural Gas Co.—138 miles, 20-22-in., planned, Chattanooga, Tenn., to Lexington, Miss.

Williamson Gas Line Pigs* Traverse 1½R 90° Bends

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New Design
TYPE GP PIGS
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Southern Natural Gas Co.—171 miles, 16-planned, extension.

Southern Natural Gas Co.—225 miles, 16-in., planned, Colfax, Ga., extension.

Southern Natural Gas Co.—314 miles, 18-in., planned, extension.

Southern Natural Gas Co.—375 miles, 24-in., planned, Gwinville, Miss., to Atlanta, Ga.

Southern Union Gas Co.—78 miles, 8-10-14-in., planned, New Mexico loops and laterals.

Tennessee Gas Transmission Co.—102 miles, 16-in., under way, Bayou Sale to Kinder, La.; Latex Construction Co., contractor. H. L. Peake, superintendent.

Tennessee Gas Transmission Co.—63 miles, 26-in., under way, south bank of Mahoning River, near Youngstown, Ohio, and extending southwestward. H. C. Price, contractor. G. A. Reutzel, Columbiana, Ohio, superintendent.

Tennessee Gas Transmission Co.—63 miles, 26-in., under way, north bank of Muskingum River, and extending northeastward. H. C. Price Co., contractor. R. K. Shivel, Zanesville, Ohio, superintendent.

Tennessee Gas Transmission Co.—47 miles, 26-in., under way, south bank of Muskingum River, and extending southwestward, early fall; H. C. Price Co., contractor. W. B. Williams, McConnelsville, Ohio, superintendent.

Tennessee Gas Transmission Co.—47 miles, 26-in., under way, north bank of Ohio River, and extending northeastward. H. C. Price Co., contractor. C. R. Ice, Portsmouth, Ohio, superintendent.

Tennessee Gas Transmission Co.—700 miles, 20-26-in., planned, Burnaugh, Ky., to Massachusetts including 400-mile line to Buffalo.

Tennessee Gas Transmission Co.—95 miles, 20-in., under way, Natchitoches to Kinder, La.; Latex Construction Co., contractor. F. A. Silar, superintendent.

Tennessee Gas Transmission Co.—992 miles, 30-in., planned, first 150 miles of loops to be laid at Monroe, La., Greenville, Miss., Midland and Portland, Tenn.

Tennessee Gas Transmission Co.—70 miles, 26-30 in., contracted, between Stations 104 and 110; Anderson Brothers Corp., contractor. E. C. McCoy and Arkie Hobson, Richmond, Ky., spreadmen.

Tennessee Gas Transmission Co.—174 miles, 30-in., under way, western Tennessee and Kentucky; Price-Morrison, contractor. Jack Hodges and R. L. McMillon, superintendents.

Tennessee Gas Transmission Co.—74 miles, 30-in., under way, from near Glasgow northeastward to near Lebanon, Ky; Morrison Construction Co., contractor. R. L. McMillon, Scottsville, Ky., spreadman.

Tennessee Gas Transmission Co.—28 miles, 30-in., under way, near Scottsville, southwestward to near White House, Tenn.; Morrison Construction Co., contractor. R. L. McMillon, Scottsville, Ky., spreadman.

Tennessee Gas Transmission Co.—99 miles, 30-in., under way, near Dickson, southwestward to near Selmer, Tenn.; H. C. Price, contractor. Jack Hodges, Dickson, Tenn., spreadman.

Tennessee Gas Transmission Co.—170 miles, 26-30-in., contracted, Kentucky; Anderson Brothers Corp., contractor.

Texas Eastern Transmission Corp.—1,400 miles, 26-in., planned, Texas to Pittsburgh, loops.

Texas Gas Transmission Corp.—33 miles, 12-in., authorized, Slaughters, Ky., to Evansville, Ind.

Texas Gas Transmission Corp.—723 miles, 26-in., under way, Lisbon, La., to Middletown, Ohio.

Texas-Illinois Natural Gas Pipeline Co.—58 miles, 20-in., lateral from Joliet terminal to connection with Natural Gas Pipeline Co. of America near Volo, Ill.

Texas-Illinois Natural Gas Pipeline Co.—1,300 miles, 30-in., approved, Corpus Christi area to Joliet, Ill.

Texas-Illinois Natural Gas Pipeline Co.—100 miles, 26-in., under way, La Gloria to Refugio, Tex.; Midwestern Constructors, Inc., contractor of Schedule 1.

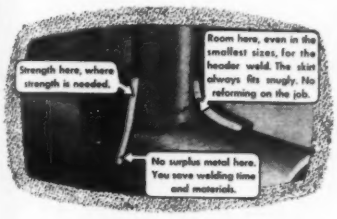
Texas-Illinois Natural Gas Pipeline Co.—100 miles, 30-in., under way, Mississippi

FLEET-LINE*

FORGED STEEL WELDING

PIPE SADDLES

ASTM A234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Department "O"

New Orleans 15, U.S.A.

River to Effingham, Ill.; Midwestern Constructors, Inc., contractor of Schedule 11.

Texas-Illinois Natural Gas Pipeline Co.—117 miles, 30-in., to start in 1951, Effingham to Sibley, Ill.; Midwestern Constructors, Inc., contractor to Schedule 12.

Texas-Illinois Natural Gas Pipeline Co.—92 miles, 30-in., to start in 1951; Sibley to Joliet, Ill.; Midwestern Constructors, Inc., contractor of Schedule 13.

Texas-Illinois Gas Pipe Line Corp.—409 miles, 30-in., contracted, Arkansas and Missouri; Bechtel Corp.

Texas-Illinois Gas Pipe Line Corp.—126 miles, 30-in., contracted; H. C. Price, contractor.

Texas-Illinois Gas Pipe Line Corp.—113 miles, 30-in., contracted; H. C. Price, contractor.

Texas-Illinois Gas Pipe Line Corp.—97 miles, 26-in., contracted; H. C. Price, contractor.

Texas-Illinois Gas Pipe Line Corp.—36 miles, 24-in., contracted; H. C. Price, contractor.

Texas-Illinois Gas Pipe Line Corp.—38 miles, 12-in., contracted; H. C. Price, contractor.

Transcontinental Gas Pipe Line Corp.—1,840 miles, 30-in., under way, Rio Grande Valley, Texas, to New York City.

Transcontinental Gas Pipe Line Corp.—80 miles, 10-14-in., underway, Mercedes to south of Falfurrias, Tex.; Massey Construction Co., contractor of Schedule A.

Transcontinental Gas Pipe Line Corp.—108 miles, 24-in., under way, south af Falfurrias to Edna, Tex.; H. B. Zachry Co., contractor of Schedule B.

Transcontinental Gas Pipe Line Corp.—93 miles, 30-in., under way, Porters to Deweyville, Tex.; Texas Southern Contracting Co., contractor of Schedule D. Merle Tatum, Liberty, Tex., spreadman.

Transcontinental Gas Pipe Line Corp.—81 miles, 30-in., under way, Sabine River, to Eunice, La.; Anderson Bros. Corp., contractor of Schedule E.

Transcontinental Gas Pipe Line Corp.—100 miles, 30-in., under way, Catawba River, North Carolina, to North Carolina-Virginia boundary; R. H. Fulton & Co., contractor of Section 9. A. A. Corrigan and Clark Williams, superintendents.

Transcontinental Gas Pipe Line Corp.—86 miles, 30-in., under way, North Carolina-Virginia boundary to James River, Virginia; O. R. Smith Contracting Corp., contractor of Section 10. R. M. Jones, Altavista, Va., spreadman.

Transcontinental Gas Pipe Line Corp.—110 miles, 30-in., under way, James River, Virginia, to Potomac River, Virginia; O. R. Smith Contracting Corp., contractor of Section 11. C. C. Craig, Herndon, Va., spreadman.

Transcontinental Gas Pipe Line Corp.—75 miles, 30-in., contracted, Potomac River to Susquehanna River; Associated Pipe Line Contracting, Inc., contractor of Section 12. Cecil Rogers, Towson, Md., spreadman.

Transcontinental Gas Pipe Line Corp.—90 miles, 30-in., contracted, Susquehanna, Pa., to Delaware River; Wunderlich & Griffis Construction Co., contractor of Section 13.

Transcontinental Gas Pipe Line Corp.—61 miles, 30-in., contracted, Delaware River to Hackensack River, New Jersey; Wunderlich & Griffis Construction Co., contractor of Section 14.

Transcontinental Gas Pipe Line Corp.—23 miles, 30-in., under way, Edgewater to Elizabeth, N. J.; Oklahoma Contracting Co., contractor to Schedule 15. Louis Visentine, Edgewater, N. J., superintendent.

Transcontinental Gas Pipe Line Corp.—98 miles, 6-14-in., under way, Wharton, Tex., area; Altgelt Construction Co., contractor, Texas Unit 1.

Transcontinental Gas Pipe Line Corp.—58 miles, 4-14-in., under way, El Campo, Tex., area; T & R Construction Co., contractor, Texas Unit 1.

Transcontinental Gas Pipe Line Corp.—38 miles, 4-8-in., under way, Sinton, Tex., area; Shanks & Eustace, Inc., contractor, Texas Unit 2.

Transcontinental Gas Pipe Line Corp.—380 miles, 8-16-in., planned, laterals to gas field.

PIPE CUTTING AND BEVELING

Crose pipe cutting and beveling machine for fast true cutting and beveling of pipe. Available in six sizes for 4" to 36" pipe. All machines are built of high strength, light weight aluminum alloys. The continuous ring which goes around the pipe is hinged so that these machines may be installed as easily from the side of the pipe as from the end. Machines for 16" pipe and above have "Out-of-Round" attachment as standard equipment.

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M. J.

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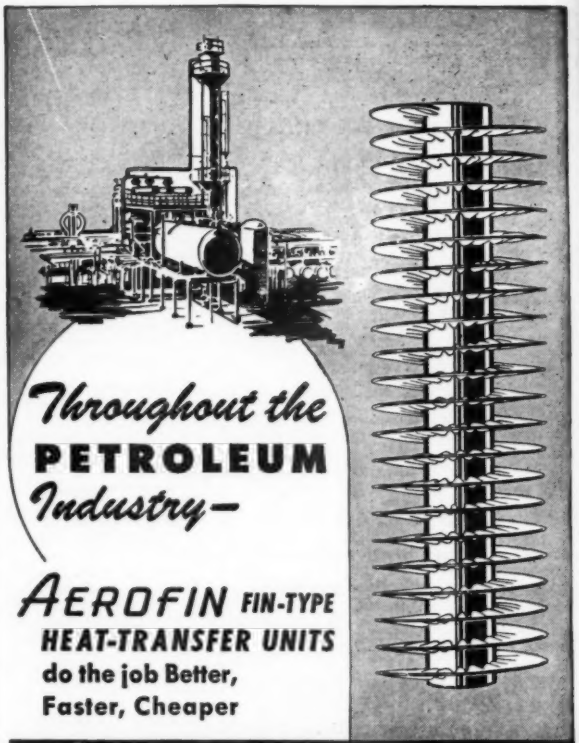

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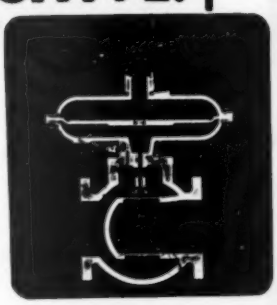

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REFINING

Refinery Strike Settled

ST. LOUIS.—Shell Oil Co.'s Wood River refinery at Roxana, Ill., has resumed operation following settlement of a month-long strike. An hourly wage increase of 11 cents was granted the 1,100 operating engineers involved in the immediate issue.

Other unions in the refinery are expected to settle their wage and condition dispute on the basis set for the engineers. Strike of the operating engineers kept the refinery closed after other striking unions had cancelled their walkout.

The increase, granted also to all other employes, sets the hourly rate of a first-class union craftsman at $2.13.

Lubrication Panel

CLEVELAND.—The American Society of Lubrication Engineers will conduct a panel on lubrication during the Plant Maintenance Show, January 15-18, 1951. Subjects of discussion will be directed to improved methods of plant operation.

Treasury Collections

WASHINGTON. — Treasury collections from the gasoline tax topped the $350,000,000 mark in August, a month earlier than last year, it was reported last week by the Internal Revenue Bureau.

Totaling $350,226,420 for the first 8 months of the year, collections were $31,500,000 over the $318,709,050 secured in the corresponding period last year.

Receipts from pipe-line transportation also were running ahead of 1949, totaling $13,330,681 against $12,352,790, but revenue from lubricating oils was off, amounting to $55,149,004 against $56,719,781.

August collections included $52,018,883 from gasoline against $49,116,140 in the same month last year; $9,971,709 from lubricating oils against $10,268,254, and $2,105,304 from pipeline transportation against $1,811,875.

New Refinery Record

Rated capacity of 175,800 bbl. daily was surpassed by 15 per cent in August, giving the Whiting refinery of Standard Oil Co. (Ind.) a new record of 200,764 bbl. daily. The new record surpasses any previous total by 5,515 bbl. of crude oil and natural-gas liquids daily.

The two conditions motivating the new Whiting record were the Army demand for high-octane gasoline, and the unprecedented winter demand for home-heating oils. Production of distillates was maximized for the emergency.

Coking Unit Completed

EL DORADO, Ark.—Production of petroleum coke will begin shortly in the new refinery unit now completed by Pan-Am Southern Corp. The undisclosed cost of the facility is estimated in the millions.

Construction work on the 4-acre

NELSON REFINERY-CONSTRUCTION INDEX

Appears in the first issue of each month.
Explanation—Cost-imating No. 61, December 15, 1949, pages 91, 92.
Compiled by W. L. Nelson—Refinery Consultant—Tulsa.
Indexes of Individual Equipment Items—January, April, July, October.

INDEX (1946 = 100)

	1947	1948	1949	June 1950
Centrifugal pumps	109.0	120.0	118.9	123.7
Reciprocating pumps	128.5	138.1	144.6	139.6
Compressor	114.0	128.0	120.0	117.0
Engines	109.0	120.0	115.6	113.2
Motors	110.0	112.7	114.0	129.0
Transformers	116.0	116.0	116.0	98.7
Instruments	113.0	120.0	122.0	123.8
Miscellaneous equipment average	114.2	122.1	121.6	120.9
Materials component	122.4	139.3	143.6	146.8
Labor component	113.5	128.0	137.1	143.9
Refinery construction index	117.0	132.5	139.7	145.1

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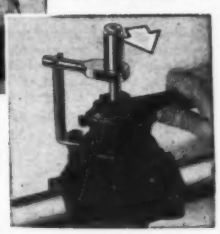

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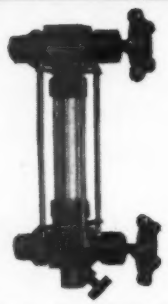

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The "All Iron" is one of the complete line of Penberthy gages that meet every liquid level gage requirement.

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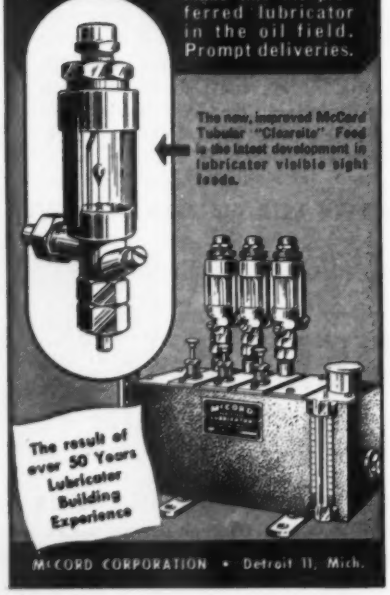
The new, improved McCord Tubular "Clearsite" Feed is the latest development in lubricator visible sight feeds.
The result of over 50 Years Lubricator Building Experience

McCORD CORPORATION • Detroit 11, Mich.

plant started in November 1949, the site chosen being a slope to facilitate loading and shipping operations. Among several innovations said to have been incorporated in the plant is a new-type panel control.

The reported daily capacity of petroleum coke is 400 tons, requiring 9,300 bbl. of crude residue oil. Output will be sold to Great Lakes Carbon Co.

The new coker has two drums, each 17½ ft. in diameter, and 95 ft. in height. One of the two fractionating columns is 240 ft. in height.

New Refinery Readied

LIMA, Ohio.—Completion of the new Standard Oil Co. (Ohio) refinery has reached the stage where the public will be invited to inspect the $30,000,000 plant on October 13-14.

The improvements include a cat cracker, lube plant, crude coker, and numerous facility units. According to Seward R. Bolles, refinery manager, the expansion will double present capacity of the plant and represent 20 per cent of the company's total investment in equipment and plants.

Oil-Drum Shortage

NEW YORK.—Steel drums for petroleum products have been classified as a critical shortage. Officers of the Steel Shipping Container Institute are now working with the National Production Authority to alleviate the situation.

Normal container demand runs 1,000,000 tons of sheet metal annually. Industry is now receiving less than 85 per cent of these requirements, with prospect of further reduction.

Platinum Catalyst Popular

CHICAGO.—A special catalyst containing percentages of platinum will be employed by six refiners who have signed contracts for installation of the Platforming process with Universal Oil Products Co., Chicago. The combined refineries will have a daily capacity of 12,800 bbl.

Two of the new installations are reported to be in Oklahoma, two in Michigan, and the others in Pennsylvania and Texas.

Universal claims the new process produces gasoline which cannot be made to knock in any standard automotive engine at even maximum tuning.

The first refinery using the Platforming process went on stream in Muskegon, Mich., in October 1949. The life of the catalyst is reported to have outlived its expectancy in this practical test. Gasoline processed by the process has been given the name of "platformate."

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2—Black markings stand out sharply against the chrome white background . . . and they are *durable.*
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7—Smooth manual blade operation.
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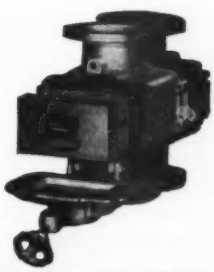

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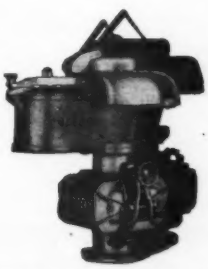
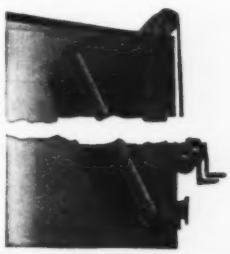


TYPE "BE" VENT UNITS consist of a V-113 Vent Valve with snuffer, mounted on a Type "E" "Extensible" Bank Flame Arrestor. 2" to 10" sizes. Unsurpassed for efficiency and reliability.



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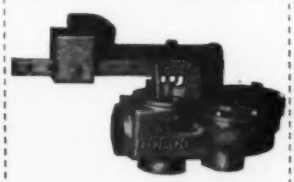

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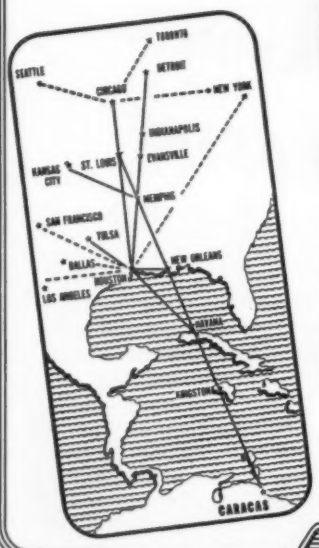

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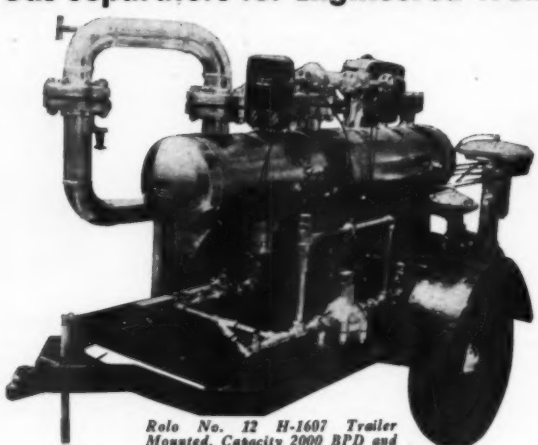

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Made in all sizes to fit any operation, Rolo Wellcheckers are shipped with all controls, piping and accessories ready to operate. Rolo Wellcheckers enable the operator to check production daily and to secure accurate records for royalties and taxes. See Composite Catalog or write for illustrated bulletin.

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NATURAL GAS

Phillips Hearing Postponed

WASHINGTON. — Hearings in the Federal Power Commission's investigation of the natural gas operations of Phillips Petroleum Co. to determine whether that company comes within the jurisdiction of the Natural Gas Act, have again been postponed, this time until January 8, 1951.

The Phillips case has been pending for many months, having been initiated even before enactment and subsequent veto by President Truman of the Kerr bill. A hearing set for September 11 was postponed in August until October 9 at the request of the company, and the new postponement also was at Phillips' request, supported by the Oklahoma Corporation Commission and Texas Railroad Commission.

The company urged that the hearings be deferred at least until after the end of this year and preferable until the termination of the present war emergency, on the ground that its principal witnesses are key employes of vital importance in the production of war materials.

Kansas Refund Ordered

TOPEKA.—A refund of $300,000 to 366 commercial and industrial users of natural gas in Kansas has been ordered by the Kansas Corporation Commission in a directive to Cities Service Gas Co. The demand was approved by the Federal Power Commission.

The company, subsidiary of Cities Service Co., had collected the money in higher rates between December 23, 1948, and August 24, 1950. An error in interpreting an FPC order caused the supplier to charge consumers at the domestic rate rather than the industrial rate. Firms affected used less than 150,000,000 cu. ft. of natural gas monthly. Some city governments were also involved.

Gas Reserves Cited

United Gas Corp. now has roughly 11 per cent of the nation's total proved gas reserves, according to estimates made by Ralph E. Davis, independent natural-gas consultant. United's reserves are approximated at 20,377,000,000,000 cu. ft. of natural gas.

This estimate was made in connection with the system's pending application before the Federal Power Commission to build 1,130 miles of high-pressure 30-in. pipe line to reinforce and enlarge its present 6,700-mile system.

United's estimated reserves have increased 25 per cent in the past year. This supply is considered assured from the company's own discoveries as well as its large-scale gas-purchase program.

The proposed pipe line is expected to cost $115,000,000. Delivery of steel pipe is scheduled to begin in December, with completion set for September 1951.

Gas Allocation Sought

WASHINGTON. — Days with zero temperature were offered the Federal Power Commission as a peak standard for allocating natural-gas supply this winter to Michigan, Indiana, and Missouri distributors. Panhandle Eastern Pipeline Co., supplying the natural gas, contends that an all-zero day is a false estimate of demand.

Executives of five distributing companies testified they anticipated full-zero days during the approaching winter, basing their estimates on past weather records. Such a cold snap would demand 620,000,000 cu. ft. of natural gas daily to meet the requirements for home heating. Capacity of Panhandle is limited to 550,000,000 cu. ft. of natural gas daily.

Fear of a cold winter was cited as basis for the following increased demands by distributor companies: Albion (Michigan) Gas Light Co., 3,500,000 cu. ft. compared with last year's high of 2,683,000 cu. ft.; Ohio Valley Gas Corp., Winchester, Ind., 2,174,000 and 2,618,000 cu. ft.; Greenfield, Ind., Gas Co., 2,433,000 and 3,987,000 cu. ft.; Missouri Western Gas Co., Butler, 1,708,000 and 2,048,000 cu. ft.; and Citizens Gas Co., Hannibal, Mo., 4,922,000 and 6,997,000 cu. ft.

Natural-Gas Rationing

JEFFERSON CITY, Mo.—Natural-gas rationing has been approved by the Missouri Public Service Commission to conserve a winter supply for present consumers. Authority to curtail service was given Missouri Utilities Co. and Citizens Gas Co.

In approving the regulation the commission ruled: "The danger sought to be avoided here is the bleeding of a fixed supply of natural gas by a few large consumers for nondomestic purposes at the expense and probable hazard of the general public."

All three companies buy their natural gas from Panhandle Eastern Pipeline Co. Their customers needing more than 300 cu. ft. of natural gas hourly will be required to sign contracts providing for possible curtailment, the provision to continue for 6 months.

Natural Gasoline

New Carbon-Black Plant

BORGER, Tex. — A new carbon-black plant having an annual capacity of 70,000,000 lb. will be constructed by Phillips Chemical Co. adjacent to present plants near here.

The added capacity will give the Borger units a total yearly output of 160,000,000 lb. Completion of the development is scheduled for late 1951.

Announcement of the expansion was made by K. S. Adams, president, marking the third expansion in carbon-black facilities since 1947. The original plant was doubled in capacity in early 1949, and further expanded by about 10 per cent a few months later. Its present capacity is 90,000,000 lb. annually.

Philblack O was the first H.A.F. (high abrasion furnace) carbon black offered to the industry, finding an important market in the manufacture of cold rubber. Made entirely from liquid hydrocarbons, raw materials for the enlarged output is assured from Phillips Petroleum Co. refineries.

Arkansas L.P.G. Program

LITTLE ROCK.—Arkansas is the first state officially to encourage its citizens in using liquid petroleum gas. Its state department of education is operating a series of customer-relations school as part of its program to acquaint all citizens with the modern fuel.

Short courses are designed to enable L.P.G. agents to enlighten and instruct present and prospective customers. Fundamental safety practices are stressed in the course. Films, visual aids, demonstrations, discussions and other training methods are employed in the intensive drive to popularize the product.

N.G.A.A. Meeting Set

TYLER, Tex.—Actual operating problems will be discussed at the southern regional meeting of the Natural Gasoline Association of America, to be held here October 27. This annual meeting features topics of special interest to operating men in the East Texas and Louisiana areas.

H. H. Beeson, Magnolia Petroleum Corp., will serve as chairman of the morning session, and F. G. Noble, Humble Oil & Refining Co., will preside in the afternoon session.

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More Reserves Proved for Alberta

FIVE Devonian oil discoveries in three separate areas, two of which found both the D2 and D3 zones productive, and four Cretaceous gas discoveries have hit Alberta in rapid succession in recent weeks to abruptly end a period of limited wildcat successes and to add significantly to the province's proved reserves of crude oil and natural gas.

Alberta's proved remaining reserves of crude oil are now estimated to be in the neighborhood of 1.5 billion barrels. The province's proved remaining reserves of gas may be as high as 8 trillion cubic feet. However, due to limited development in many of the younger oil and gas fields, proved reserve estimates are difficult to make and tend toward the conservative side. Also, because of restricted outlet, production is far below the maximum efficient rate and reservoir performance data for reserve calculations are incomplete or lacking in most fields.

Three fields, Redwater, Leduc-Woodbend area, and Golden Spike, are estimated to account for about 85 per cent of the 1.5 billion barrels of oil now considered proved, but there are other pools with significant reserves already developed, or indicated to be proved by development, which may ultimately be revised upward sufficiently to reduce the dominant percentage of the three giants.

Two current dual-zone Devonian discoveries for which even preliminary ultimate reserve estimates are questionable, give indications of having opened sizable producing areas. Canadian Gulf Oil Co. 7 Big Valley, about 15 miles south of Stettler, tested in excess of 1,000 bbl. daily from 39 ft. of D2 zone and at a rate of 900 bbl. daily from 11 ft. of D3 zone. Socony-Vacuum Exploration Co. 1 Flint, 40 miles north of Stettler field, tested at rates up to 700 bbl. daily from 35 ft. of D2 zone and initialed 1,100 bbl. daily from about 30 ft. of D3 zone.

Currently considered likely to develop into a major pool is the oil-saturated reef buildup indicated by three D3 wells: Imperial Oil, Ltd., 1 Stony Plain, California-Standard Co. 1 Acheson province, and Central Leduc Oil, Ltd. These three wells are on a 4-mile long north-south line about 5 miles west of Edmonton. Imperial's well initialed 100 bbl. daily from 1 ft. of perforations opposite a 6-ft. D3 section above water. The 1 Acheson province, about 4 miles north of Imperial's well drilled 121 ft. of D3 without reaching the base of the zone nor the water level and initialed over 1,200 bbl. daily. Central Leduc's well over a mile north of Imperial's well and nearly 3 miles south of California-Standard's well, got a flow of oil in 11 minutes with no sign of water in the top 6 ft. of the D3 zone. Farther up the hole this well had considerable volumes of gas in the Upper Cretaceous Viking sand and in sands of the Lower Cretaceous. It also found a probable commercial amount of oil in a 15-ft. Lower Cretaceous sand. Only 140 ft. of oil with indications of water was recovered during a 90-minute D2 test.

Up in the Peace Creek area, Shell Oil Co. and British American Oil Co., Ltd., are drilling on a test 4½ miles southeast of their 1 Whitelaw discovery. The 1 Whitelaw is producing about 150 bbl. of oil daily from the Permo-Pennsylvanian section having plugged back from granite after finding the Mississippian and Devonian barren. The well is making considerable water but the operators believe that a water shut-off can be effected. Higher in the hole behind casing the 1 Whitelaw has 500 ft. of Triassic gas-bearing sands from which drill-stem tests indicated an open flow of 40 to 50 million cubic feet of gas per day.

Other recent gas discoveries that may ultimately add significantly to Alberta's tremendous gas reserves have been made by Canadian Superior Oil Co. of California, Ltd., and Canadian Delhi Oil Corp. Canadian Superior found gas about 15 miles east of Stettler field in the Lower Cretaceous, and in the Viking sand about 120 miles east and north of Calgary. The wells, now capped awaiting outlet, are each capable of producing 3 to 5 million cubic feet of gas daily. Canadian Delhi has two 2.5 to 3.5 million cubic feet Lower Cretaceous gas discoveries nearly 10 miles apart in the Cessford area about 95 miles east of Calgary.

Philip C. Ingalls.

HIGHLIGHTS OF WEEK'S DEVELOPMENTS

TEXAS GULF COAST.—Wilcox production has been opened at C. N. Housh-American Republics Corp. 1 Pearl Wooten, 2½ miles east of Columbus, Colorado County. Through perforations at 8,512-40 ft., the well flowed 50 bbl. of 52°-gravity distillate per day through ¼-in. choke. Tubing pressure was 1,775 psi. (See field report this week.)

WEST TEXAS.—C. W. Murchison 1 Joe Cannon, southwestern Midland County wildcat northwest of Pegasus field, had flowing oil from top of the Pennsylvanian. The flow was estimated up to 35 bbl. of oil an hour, into pits, on a 4-hour drill-stem test from 10,370-578 ft. Some reports had top of the Pennsylvanian pay section around 389 ft. low to Magnolia 1-A TXL, discovery well in the field.

ROCKY MOUNTAIN AREA.—General Petroleum Corp. has made a new discovery along the east side of the Big Horn Basin, Wyoming, with its Slick Creek wildcat flowing 50 bbl. of oil daily from Embar. Shell Oil Co. will use Hydrafrac at the Buckingham, Weld County, Colorado, Muddy sand discovery after it made 41 bbl. of oil per day on swab.

CANADA.—Alberta's reserves were boosted considerably by three good wells: Texaco and McColl-Frontenac's South Calmar discovery; Central Leduc, Del Rio, and Cohen-Finkelson Group's Acheson oil strike; Socony-Vacuum's Camrose dual-zone hit. (See detailed field report, this issue.)

XUM

Kansas

Maximum Potentials Set By Two Discovery Wells

TWO more discovery wells have been completed with maximum potential ratings (3,000 bbl. per day). One is Skelly Oil Co. 2 Thoewe, SW SE NE 2-13-10e, Wabaunsee County, in the Forest City basin, in the northeast part of the state. It opens the Mill Creek pool with production from Viola lime, topped at 2,923 ft. (—1816 ft.) and drilled to 2,927 ft. Hole is open below 2,924 ft. Drilling already is under way at a north offset, 1 Powell, NW SE NE 2-13-10w.

The other is Jones, Shelburne & Farmer 1-A Sutter, SW SW NE 2-10-21, southeastern Graham County, at the upper end of the Central Kansas Uplift trend of pools. It opens the South DeYoung pool with production from Arbuckle lime at 3,839-47 ft. It is only a little over ½ mile southeast of the DeYoung pool and about the same distance northeast of the Northwest Bass pool, both recent discoveries in the active exploration and development play which has been going on around the Morel pool area.

In northwestern Ellis County, The Texas Co. has completed its 1 Fries, SE SE NW 10-12-20, to open the Sweet William pool. The well pumped 25 bbl. of oil daily on potential tests. Production is from Arbuckle lime, topped at 3,906 ft. (—1,704 ft.). Total depth is 3,919 ft. with 7-in. casing bottomed 2 ft. in the top of the pay.

Confirmation of the recent discovery of the East Sugar Loaf pool, also in Ellis County, has been given by the completion by Derby Drilling Co. and associates of their 1 Webster, SW NE SE 20-13-17, pumping 278 bbl. of oil daily from the Lansing-Kansas City section. Casing is perforated at 3,438-46 ft. and 3,422-30 ft. Total depth is 3,623 ft. with 5-in. casing at 3,623 ft. The well is southwest of the discovery producer.

Aladdin Petroleum Corp. and Crowe Drilling Co. 1 Habiger, SW SW NW 1-19-12, ¾ mile north of production in the Cheyenne View pool, Barton County, swabbed 48 bbl. of oil in 18 hours to add another important extension to this steadily expanding area. Total depth is 3,405 ft. in conglomerate, topped at 3,387 ft. (—1,555 ft.). Hole is open below 2,288 ft.

Production of the Nettie pool in southern Rooks County is being extended ½ mile westward at Strain Drilling Co. and associates 1 Schrandt, NE NE NW 4-10-17. Following a 500-gal. acid treatment of its pay zone, the well swabbed at the rate of 25 bbl. of oil per hour in a 4-hour test. Production is from Arbuckle lime at a total depth of 3,534 ft. Top of the zone was logged at 3,528 ft. (—1,427 ft.). Hole is open below 3,530 ft.

Alpine Oil & Royalty Co. has run casing to test oil and gas showings found in the Lansing zone in its 1 Bantam, SW SW SW 15-1n-19w, a wildcat in Harlan County, Nebraska. A drill-stem test at 3,613-38 ft. in this zone, topped at 3,462 ft. (—1,306 ft.), yielded 2 ft. of free oil with 23 ft. of slightly oil-cut mud. Total depth is 3,720 ft. with casing at 3,704 ft. If production is established, it will open the second pool for the county, which borders Phillips County, Kansas. The location is about 6 miles northwest of the first pool, opened last summer by the same operators, and about 11 miles northwest of the active Huffstutter pool in northern Phillips County.

KANSAS SUCCESSFUL WILDCATS

Phillips County: Laura Jane 1 Jackson, SE SE NW 31-1s-18w, extension to Huffstutter, 604 bbl. of oil per day from Lansing-Kansas City at 3,503-11 ft., TD 3,526 ft.

Rice County: Bradley 1 Bernstaff, NW SE SE 16-19s-10w, 150 bbl. of oil per day from Lansing-Kansas City at 3,062-68 ft., TD 3,375 ft., PB 3,200 ft.

Stafford County: Adair 1 Brenn, SW SW SE 1-21s-12w, 25 bbl. of oil per day from Arbuckle at 3,451-58 ft., TD 3,498 ft.

KANSAS WILDCAT FAILURES

Barton County: Shields and Anschutz 1 Miller, SE SE SE 2-16s-11w, dry, TD 3,332 ft.

Alpine 1 Jenisch, NE NE SW 13-17s-12w, dry, TD 3,370 ft.

Welch, Olsson & Allison 1 Hiss, SE SE SW 25-19s-14w, dry, TD 3,520 ft.

Coppinger et al 1 Steckel "A," NW SW NE 22-20s-12w, dry, TD 3,448 ft.

Henderson Oil 1 Petz, NE NE NW 22-19s 12w, dry, TD 3,532 ft.

Herndon 1 Riedl, SW SW SW 3-18s-13w, dry, TD 3,370 ft.

Greenwood County: Giffin 1 Moore, CNL SE NE 35-26s-10e, dry, TD 1,404 ft.

Darling et al 1 Pate, NE SW NE 32-26s-11e, dry, TD 1,928 ft.

Logan County: Lebsack et al 1 Settle, NE NW NE 4-13s-36w, dry, TD 4,611 ft.

Marion County: Basco 1 DeForest, NW NW SW 36-20s-4e, dry, TD 2,585 ft.

McPherson County: Hartman 1 Otte, NE NE NW 30-20s-1w, dry, TD 3,664 ft.

Pawnee County: Vickers 1 Damm, SW SW SE 2-21s-15w, dry, TD 3,830 ft.

Rooks County: Keys 1 Andreson, NW NW SW 3-10s-17w, dry, TD 3,537 ft.

Saline County: Ingling et al 1 Anderson, NE NW SE 10-16s-2w, dry, TD 3,603 ft.

Stafford County: Musgrove 1 Crouse, NW NW SE 6-24s-14w, dry, TD 4,151 ft.

Mississippi

Kingston Field Venture Recovers Oil on Tests

JACKSON.—A second producer for Kingston field, Adams County, seems assured at Stanolind Oil & Gas Co. 1 G. W. Armstrong, 11-5n-2w, west offset to the discovery well. On drill-stem test of perforations at 6,488-90 ft., the well flowed 57 bbl. of oil in 6 hours through ½-in. top and ¾-in. bottom chokes. Top pressure was 520 psi. and bottom-hole pressure was 2,735 psi. Perforations are in the Wilcox sand, which carried shows in sidewall samples at 6,488-93 ft. Previous drill-stem tests at 6,643-46 ft., 6,583-85 ft., and 6,487-90 ft. recovered salt water

Clyde E. Moss and Frederic F. Mellen have cored salt water sands at three intervals in the Eutaw section at their 1 Sullivan L. Latham, wildcat in 21-8n-6e, Scott County. Conventional cores were taken at 5,204-14 ft., 5,220-30 ft., and 5,268-76 ft., and all recovered salt water.

In Amite County, Humble Oil & Refining Co. ran 9⅝-in. protection casing to 8,939 ft. in its 1 W. A. Stockard et al, SE SW 33-1n-6e. Detailed information is not being released on the wildcat, but it is reported that operators are coring below 11,665 ft., and that shows of gas which caused trouble with the drilling mud was the reason for setting protection string.

In North Natchez field, Adams County, Humble found its 1 A. B. Dille et al dry at 10,278 ft. Located in 16-8n-3w, the well is slightly over ½ mile north of the pool opener.

In Clarke County, Alabama, Danciger Oil & Refining Co. and California Co. 1 John F. York will be deepened an additional 1,000 ft. from its present depth of 12,517 ft. Coring has been continuous in the well from 11,467-12,469 ft., with recovery being anhydrite, lime, shale, and salt. A slight oil show was noted at 11,582-86½ ft. and at other points between 11,667-11,868 ft.

MISSISSIPPI WILDCAT FAILURES

Adams County: Kemp Drilling Co. et al 1 L. A. Whittington, 42-7n-1w, dry, TD 6,512 ft.

Midstates Oil Corp. 1 C. Ferriday Byrnes, dry, TD 6,620 ft.

Jefferson County: Kemp Drilling Co. and Pan-Am Southern Corp. 1 W. J. Colbert, dry, TD 6,511 ft.

Wilkinson County: Petersen Drilling Co. and J. D. Lander 1 W. H. Catchings et al, dry, TD 7,514 ft.

Michigan

Antrim County Wildcat Finds Two Zones Dry

MOUNT PLEASANT.—Ohio Oil Co. failed to log shows at its 1 State-Custer, NW SW NW 16-29n-7w, Custer Township wildcat, Antrim County. Neither oil nor gas was found in either the Dundee or top Monroe objectives, although over 2,000,000 cu. ft. of gas was gaged in the Traverse on a drill-stem test. This wildcat, after drill-stem tests in both the Dundee and Monroe failed to show, was being drilled ahead towards the Richfield, ultimate objective. The Dundee was logged at 1,825 ft. and Reed City-Monroe at 1,903-36 ft. The Richfield should be topped at about 3,350 ft. Drilling was currently below 2,080 ft.

O. H. O'Neal was swabbing at the rate of 30 bbl. of oil every 7 hours, natural, at his 2 Winchester, NW NW NW 21-14n-10e, Elmwood Township, Tuscola County, and appeared to have the best producer yet drilled in the pool. Beside the discovery well, at which operations have been discontinued, there are two other wells in the pool, one a Traverse gas well and one a Dundee oil well. O'Neal logged the Dundee at 2,552 ft. in the 2 Winchester and hole was bottomed out at 2,742 ft. with 1,500 ft. of free oil showing natural in 24 hours. Pay was drilled from 2,730-42 ft. This well will be tubed and acidized.

Michigan Supervisor of Wells, P. J. Hoffmaster, issued an emergency spacing order establishing diagonal northeast - southwest 20-acre spacing for Traverse wells in Butman field, Gladwin County, effective September 27. The order will remain in force for 20 days, but may be made permanent following a public hearing of the State Oil Advisory Board which is scheduled to be held at Lansing October 17. The order was deemed necessary when H. E. Bell logged a flowing Traverse well at his 1 Serlin & Kaminsky, NE NE SW 12-20n-1w, Butman Township, Gladwin County. It showed en route to the Richfield, and flowed as much as 320 bbl. in 16 hours, natural, from the Traverse at 2,791 ft., total depth, but this week was being equipped with rods for pumping with a water-cut showing.

MICHIGAN WILDCAT FAILURES

Allegan County, Manlius Township: George F. Lister 1 Gamby, NE SW SE 16-3n-15w, Traverse 1,364 ft., dry, TD 1,418 ft.

Valley Township: Cook Drilling Co. 1 Sirrine & Consumers Power Co., SE NE NE 15-2n-14w, Traverse 1,337 ft., dry, TD 1,343 ft.

Clare County, Frost Township: Saginaw-Bay Petroleum Co. D-1 State-Frost, SE SE NW 29-20n-4w, Dundee 4,161 ft., dry, TD 4,246 ft.

Kalamazoo County, Alamo Township: Ford Oil Co. 2 Kokmeyer, Jr., NW SW NW 31-1s-12w, Traverse 1,280 ft., dry,, TD 1,283 ft.

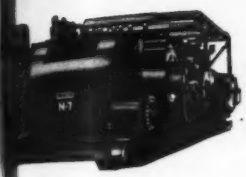
Livingston County, Unadilla Township: Frank R. Schrot 1 Read, SE NW SW 16-1n-3e, Berea 1,134 ft., dry, TD 1,148 ft.

Newaygo County, Ashland Township: Augie Busk 1 Wheat et al, SE SE NE 5-11n-13w, Traverse 2,246 ft., dry, TD 2,258 ft.

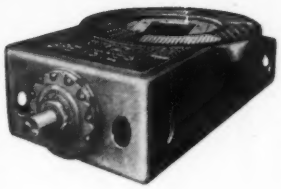
Osceola County, Richmond Township: Louis Rose 1 Bittner, NW SW SE 19-17n-10w, Dundee 3,603 ft., dry, TD 3,770 ft.

Otsego County, Hayes Township: Sun Oil Co. 1 North Mich. Land & Oil Corp., SW SW SW 27-29n-4w, Traverse 2,023 ft., dry, TD 2,110 ft.

Ottawa County, Zeeland Township: John R. Atha 1 Roelofs, SW NW NW 17-5n-14w, Traverse 1,606 ft., dry, TD 1,731 ft.



N-7 DRAWWORKS
for 8500' Drilling



RS-22
OILBATH ROTARY

200 TRAVELING BLOCK

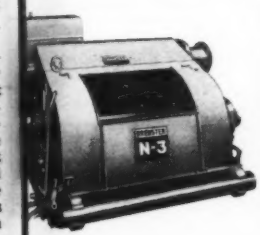
6-S OILBATH SWIVEL

N-4 DRAWWORKS
for 5000' Drilling

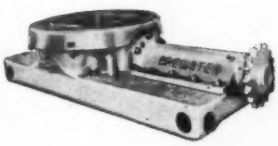
RS-18
OILBATH ROTARY

H-100 HOOK BLOCK

4-S OILBATH SWIVEL



N-3 DRAWWORKS
for 3500' Drilling



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H-50 HOOK BLOCK

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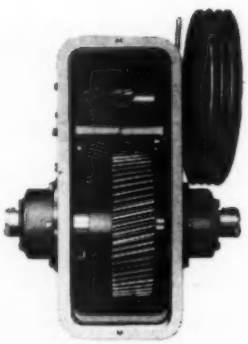

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First Oil Production for Harper County Indicated

TANKS and separator are being set to complete what may prove to be the first oil well for Harper County, in the little-explored extreme northwestern part of the state. The prospective rank wildcat discovery well is H-E-R Drilling Co. 1 Harrison-Selman, C NE SE 33-26n-20w, southwest of Salt Springs, in the southeastern part of the county, and more than 25 miles from nearest production of any kind.

Preliminary production tests have been made in two zones. From casing perforations at 6,494-6,506 ft. and 6,509-19 ft. in Chester lime, where first tests were made, the well after the zone had been treated with 6,000 gal. of acid, flowed by heads at the rate of 3 to 4 bbl. of net oil and 1,000,000 cu. ft. of gas per day. Gravity of the oil was 32° A.P.I.

The flow from this zone then was killed and casing perforated in a higher zone at 6,464-86 ft. From this zone, after it had been given an 8,000-gal. acid treatment, the well flowed initially at the rate of 15 bbl. of fluid, 15 per cent oil, per hour. Flow declined to from 1 to 2 of fluid per hour but with an increase in net oil to around 50 per cent. Gas flow, estimated initially at 1,000,000 cu. ft. per day, has been increasing.

Total depth of the hole, drilled by Davon Oil Co. and recently taken over by the present operator, is 7,005 ft. with 5½-in. casing at 6,558 ft.

V. A. Brill and associates have completed their 1 Riordan, SE SE NE 16-8n-1e, discovery well of the Roulette Creek pool, located 15 miles southeast of Norman in eastern Cleveland County. Producing from the second Wilcox sand, in which hole is open at 6,417-27 ft., the well flowed 343 bbl. of 41° oil in 24 hours through 16/64-in. choke. Flowing pressure on tubing was 450 psi. Casing pressure was 500 psi.

New Hunton lime production is being opened just west of Prague, Lincoln County, where Ned E. Biffle 1 Way, NW NW SE 19-12n-6e, flowed at the rate of 10 bbl. of oil per day through ½-in. choke in initial tests of that zone, topped at 4,423 ft. Casing, which had been run to 4,635 ft. to test the Wilcox, is perforated in the Hunton at 4,432-38 ft. Attempts to test the Wilcox, drilled to 4,700 ft., failed when water broke in. A drill-stem test and the electric log had given indications of production in the latter prospective pay zone, topped at 4,690 ft. The location is about ½ mile from an abandoned small producer which had constituted the West Prague pool. Locations already have been made for two offsets.

About 6½ miles southwest of the Biffle well, Anderson-Prichard Oil Corp. has another prospective oil discovery at its 1 Bartodej, NW SW SE 32-12n-5e, which testing showings found in the second Wileox sand, swabbed at an average rate of more than 11 bbl. per hour for 12 hours. Total depth is 5,053 ft. with 5½-in. casing at 5,030 ft. Top of the zone had been logged at 5,028 ft.

Delany Drilling Co. 1 Little, NE NE SE 17-13n-5e, a mile south of the East Sparks pool, southeastern Lincoln County, flowed at an estimated rate of 20 to 25 bbl. of oil per hour for 10 minutes after being bailed down and cleaned. Separators and tanks are being set for testing. Prospective pay zone is the Prue sand, topped at 3,535 ft. and drilled out to a total depth of 3,557 ft. The location is on a line between the East Sparks pool and the South Sparks pool, 1½ miles to the southwest, and may prove a link in connecting the two pools.

W. H. Elson 1 Hesser, NE NE SW 4-19n-3e, a wildcat 3 miles northeast of Stillwater, Payne County, has uncovered a second prospective pay zone, the Red Fork sand, topped at 3,966 ft. A drill-stem test

in this pay at 3,968-81 ft. got a good flow of gas and yielded 30 ft. of clean oil and 120 ft. of oily mud in the break-down. Previously, the well had found good saturation in the Cleveland sand at 3,514-38 ft. Hole is drilling ahead for a look at the Wilcox.

OKLAHOMA SUCCESSFUL WILDCATS

Lincoln County: Blackwell 1 Freeman, NW SE NE 18-14n-5e, 300 bbl. of oil per day from Wilcox at 4,742-48 ft., TD 4,786 ft., PB 4,774 ft.

Payne County: H. Waggoner & Co. 1 Maitten, SW SW NE 7-18n-6e, 70 bbl. of oil per day from Red Fork at 3,094-3,114 ft., TD.

Stephens County: Sinclair 1 Arnett, NE SE NE 3-2s-4w, 476 bbl. of oil from Velma sand at 5,896-6,179 ft., TD 6,330 ft.

OKLAHOMA WILDCAT FAILURES

Kiowa County: J. H. Poole 1 Gotebo dist., SE SE NE 29-7n-16w, dry, TD 718 ft.

Lincoln County: Marcel J. Silberman 1 Reggie, NE NE SW 12-16n-4e, dry, TD 4,501 ft.

Logan County: Woods Drilling 1 Jessie B. Ray, NE NE NW 13-17n-2w, dry, TD 5,136 ft.

Marshall County: Hugh Halsell et al 1 Chrisman, SW SE NW 33-6s-7e, dry, TD 997 ft.

Murray County: Calvin J. Hobson 1 Leversen, NW SW SW 6-1s-1w, dry, TD 2,515 ft.

Noble County: Summitt Drilling 1 Clark, SE SW NE 21-21n-1w, dry, TD 5,214 ft.

Okfuskee County: Davidor & Davidor 1 McKernan, SE SE SW 21-12n-9e, dry, TD 3,446 ft.

Osage County: Continental Oil Co. 1 Osage, NE SW SW 24-25n-2e, dry, TD 4,237 ft.

Pontotoc County: Atlantic Refining 1 Busbl, NE SW SE 15-4n-5e, dry, TD 2,550 ft.

Stephens County: Earl Sadler 1 Harley, NW NW NE 19-2s-6w, dry, TD 3,107 ft.

Texas Gulf Coast

Rank Wildcat Test Opens New Area

HOUSTON.—Wilcox production has been opened in Colorado County at C. N. Housh-American Republics Corp. 1 Pearl Wooten, rank wildcat 2½ miles east of Columbus. Through 168 perforations at 8,512-40 ft. the well flowed approximately 50 bbl. of 52°-gravity condensate per day, through ¼-in. choke. Tubing pressure was 1,775 psi. The hole was originally scheduled to be drilled to 12,500 ft., however due to failure to recover fish, it was bottomed at 10,021 ft. This well is 5 miles from the nearest production and will open an entirely new producing area.

Floyd L. Karsten has run a potential test on his new oil discovery, 1 Richard W. Sharp et al, 5 miles southeast of Arcola in Brazoria County. Through perforations at 7,609-11 ft., the well flowed 102 bbl. of 41.5°-gravity oil per day through 7/64-in. choke. Tubing pressure was 2,010 psi., and casing pressure 2,760 psi. It was drilled to a total depth of 8,760 ft. with 7-in. casing set at 7,857 ft. Location is in the J. S. Talmage Survey, Abstract 561.

Yegua production has been opened in the east corner of DeWitt County, at United Producing Co., Inc. 1 A. J. House, wildcat in the Thomas Barry Survey, Abstract 82. The well was perforated at 5,336-46 ft., and on drill-stem test flowed gas and condensate through ¼-in. choke. Recovery when the tool was pulled was 60 ft. of condensate and 10 ft. of fresh water. Working pressure was 1,900 psi., and bottom-hole flowing pressure 2,375 psi. Total depth was 7,806 ft. and operators ran a test of the Wilcox previous to testing the Yegua. However, the lower zone was too tight to produce and operators plugged back.

An important extension to Melbourn field, Calhoun County, is being completed at Alcoa Mining Co. and Southern Production Co. 1 L. J. Foester, Sr., outpost approximately 3,400 ft. northeast of previous production. On a drill-stem test run at 8,545-47 ft., the well flowed at the rate of 165 bbl. of oil per day through ¼-in. choke. Total depth is 9,250 ft., and operators set 7-in. pipe to 8,688 ft. for completion.

In the same county, Alcoa and Southern Production have run a potential gage on 1 Mrs. Mary A. Hubbard, gas-condensate discovery in the Benito Morales Grant, Abstract 28. Through perforations at 8,683-86 ft. and 8,690-99 ft., the well flowed 12,500,000 cu. ft. of gas per day on open flow gage with 38 bbl. of 57.1°-gravity distillate per 1,000,000 cu. ft. Bottom-hole flowing pressure was 3,937 psi., and shut-in pressure 3,120 psi.

TEXAS GULF COAST (DISTRICTS 2 AND 3) SUCCESSFUL WILDCATS

Brazoria County: New pool—Floyd L. Karsten 1 Richard W. Sharp, et al, J. S. Talmage Sur., A-561, 5 mi. SE Arcola, TD 8,760 ft., perf. 7,609-11 ft., 102 bbl. oil per day, 7/64-in. choke, TP 2,010 psi., CP 2,760 psi., gravity 41.5°.

Calhoun County: Gas discovery — Alcoa Mining Co.-Southern Production Co. 1 Mrs. Mary A. Hubbard, Gulf Coast Fruit & Land Co. Subd. of Benito Morales Gr., A-28, 2½ mi. SW Magnolia Beach field, TD 9,661 ft., perf. 8,683-86 ft. and 8,690-99 ft., 12,500,000 cu. ft. of gas per day, open flow, SIP 3,120 psi.

TEXAS GULF COAST (DISTRICTS 2 AND 3) WILDCAT FAILURES

Brazos County: Far West Oil Co.-Holly De-

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RYERSON STEEL

velopment Co.-Edwin L. Cox et al 1 John A. Arhopulos, Samuel Davidson League, 3½ mi. SW Wellborn, dry, TD 6,508 ft.

Chambers County: Eastern States Petroleum Co.-Humble Oil & Refining Co. et al 2 W. F. Mayes est., Edward Door Sur., A-74, 3½ mi. W Wallisville, dry, TD 9,875 ft.

Fort Bend County: Petroleum Management Co. 1 A. P. George, Barnabas Wickson Sur., A-95, near Big Creek field, dry, TD 4,028 ft.

Liberty County: Texas Co. 2 J. D. Williams, H&TC Sur. 123, A-262, dry, TD 7,585 ft.

Matagorda County: Brazos Oil & Gas Co. 1 State of Texas "V," (M-30,070) Matagorda Bay, State Tract 308, dry, TD 5,801 ft.

Victoria County: Taylor Refining Co. 1 Frimble, Samuel Wells Sur., A-349, ½ mi. E Telferner, dry, TD 5,748.

Ohio Fields

Two Clinton Oil Producers Noted in Licking County

COLUMBUS.—Clinton Oil Co.'s 1 Henry McCracken, Section 8, Hopewell Township, Licking County, drilled in a good oil showing, natural, and made 94 bbl. in 24 hours after shot. The Clinton sand was logged at 3,006-49 ft. In Bowling Green Township, W. C. Adair 5 S. Cooperider, Section 3, found the Clinton at 2,839-72 ft. with a good show of oil, and 420,000 cu. ft. gas, natural. In the first 24 hours after shot, the well made 240 bbl. This producer was drilled deeper from the Newburg sand and is a west offset to Hunt's Cooperider well.

The center Litchfield gas pool was extended a location to the east by Ohio Fuel Co. 2 Eliza Reisinger, Lot 26, Litchfield Township, Medina County. The Clinton sand at 2,762-74 ft. gaged 2,260,000 cu. ft. of gas, natural.

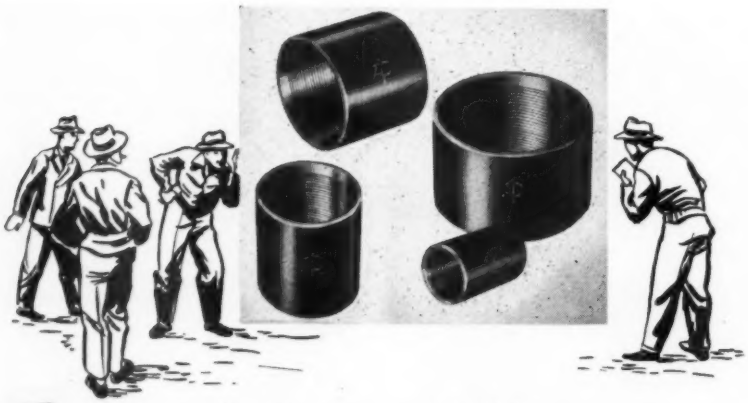
H. E. Perkins 1 Nancy Priest, Section 11, Jefferson Township, Knox County, showed only 60,000 cu. ft. of gas, natural, but responded well to a shot, and shut in at 490,000 cu. ft. with 1,100 psi. rock pressure.

J. W. Bebout 3 Mark Campbell, Section 19, Clayton Township, Perry County, topped the Berea at 950 ft. and finished at 955 ft. with 800,000 cu. ft. of gas natural.

Dave Shafer is drilling a wildcat on a large block of acreage in Mechanic Township, Holmes County. Location is on 1 Earl Galley in Section 10.

OHIO WILDCAT FAILURE

Hardin County, Taylor Creek Township: Sun Oil Co. 1 Paul Sponsler, Lot 10,000, dry, St. Peter 1,942-45 ft., TD 1,995 ft.



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South Louisiana

East and North Offsets Confirm New Oil Field

NEW ORLEANS.—Oil production has been confirmed in the new Glenmora field, Rapides Parish, with completion of Texas Pacific Coal & Oil Co. 1 J. A. Bentley, 35-1s-2w, direct east offset to the 1 Elliott, discovery well. On 24-hour test, the well flowed 412 bbl. of oil daily through a 12/64-in. choke, with tubing pressure of 2,650 psi. Production is through perforations at 10,717-19 ft. in the Wilcox.

At the direct north offset to the discovery well of the same field, Brown and Wheeler tested gas and distillate at 10,764-74 ft. in their 1 W. F. Gill. Perforations were squeezed, and at last report, operators were testing through perforations at 10,642-48 ft.

Offshore from Terrebonne Parish, Humble Oil & Refining Co. has completed its A-3 State Lease 1,428, Timbalier Bay, Block 52, for an oil discovery. The wildcat flowed at the rate of 505 bbl. daily through 7/32-in. choke on 4-hour test of perforations at 12,111-14 ft. Tubing pressure was 2,600 psi., and gravity of the oil was 36.7°. On a later test, it flowed 313 bbl. of 38.3°-corrected-gravity oil per day through 7/32-in. choke.

In the one-well Midland field, Acadia Parish, Sun Oil Co. has a possible new sand opener at is 1 Leblanc, 55-10s-2w, approximately 1¼ mile east-southeast of the discovery well. Operators have perforated at 11,636-46 ft., and at last report were running in tubing and packer to test this new sand. The discovery well, Sun 3 Lapleau estate, is producing 30 bbl. of condensate for each 1,000,000 cu. ft. of gas. If the LeBlanc try proves successful it will mean a new producing area for the parish.

In the Cox Bay area of Plaquemines Parish, Richardson & Bass are preparing to perforate for production test in their 1-H State Lease 1,794, wildcat in 4-18s-16e. The test has 7-in. liner set at 13,421 ft.

SOUTH LOUISIANA WILDCAT FAILURES

Acadia Parish: Alfred Lamson & Sam Bennett 1 August Leonards, 29-7s-1e, dry, TD 4,564 ft.

Calcasieu Parish: Walter Bradley 1 Luther-Moore Lumber Co., 5-18s-11w, dry, TD 7,000 ft.

Niloco Co. 1 Edwin F. Gayle, 3-8s-11w, dry, TD 6,755 ft.

Sohio Petroleum Co. 1 McComb-Prairie Canal, 11-11s-8w, dry, TD 11,318 ft.

Pointe Coupee Parish: Sinclair Oil & Gas Co. 2 H. M. Kimball, 29-6s-10e, dry, TD 11,286 ft.

St. Landry Parish: Dan J. Harrison, Jr. and Indiola Oil Co. 1 Turner Lumber Co., 8 mi. N Palmetto, dry, TD 11,500 ft.

Southwest Texas

Completely New Area Has Wilcox Prospect

CORPUS CHRISTI.—A new Wilcox discovery is indicated at Seaboard Oil Co. of Delaware 1 Mary K. Withers, rank wildcat 25 miles east of Encinal, BS&F Survey 40, Webb County. Drill-stem tests have been run in the well indicating gas-condensate production. The first test was run at 6,489-97 ft., using ¼-in. choke, and in 9 minutes recovery was 45 ft. of condensate-cut mud, with bottom-hole flowing pressure of 2,500 to 3,015 psi. A second test was run at 6,497-6,507 ft., using a ¼-in. choke, and in 9 minutes recovery was 40 ft. of condensate-cut mud. Working pressure of 500 psi. developed in the 9 minutes.

Texas Co. has run a potential test on its 1 Brown Gas unit, new gas-condensate discovery in the A. H. Brown Tract, between McAllen and Edinburg fields, Hidalgo County. Through ¼-in. choke, the well flowed 7 bbl. of 50.6°-gravity condensate per 1,000,000 cu. ft. of gas, testing 3,743,000 cu. ft. of gas per day. Working pressure was 2,317 psi.

LaGloria Corp. continues to test its 1 J. H. Harvey, wildcat approximately 3½ miles north-northwest of Gregory, San Patricio County. Drill-stem test run at 3,840-62 ft., using ¼ and 1-in. chokes, flowed gas-condensate with 497 psi. working pressure for 20½ minutes. After tool was closed, recovery was 150 ft. of condensate and 40 ft. of rathole mud. Bottom-hole pressures were 3,945 psi. flowing, and 4,130 psi. shut in. Another drill-stem test at 8,899-915 ft. failed when the packer gave way and recovery was lost. Test at 8,998-017 ft. recovered salt water and trace of oil.

Producers Corp. of Nevada has run a potential gage on 1 Helen Williams et al. Edwards lime discovery in Gonzales County. Through a 13/64-in. choke, the well flowed 214 bbl. of 23.6°-gravity oil daily from open hole at 5,802-5,940 ft. Tubing pressure was 390 psi., and casing pressure 480-540 psi. There was no water and the gas-oil ratio was 250-1.

SOUTHWEST TEXAS (DISTRICTS 1 AND 4) SUCCESSFUL WILDCATS

Gonzales County: New oil discovery—Producers Corp. of Nevada 1 Helen Williams et al, William C. Hargis Sur., A-273, 3½ mi. N Nixon townsite, TD 5,964 ft., open hole, Edwards lime 5,802-940 ft., 214 bbl. oil per day, 13/64-in. choke, gravity 23.6°, TP 390 psi., CP 480-540 psi.

Jim Wells County: New pay at Amargosa—George W. Graham et al 1 Lester Moore, N. Gussett Sur. 98, A-185, TD 7,020 ft., perf. Yegua 5,986-92 ft., 69 bbl. oil per day, 12/64-in. choke, TP 280 psi., gravity 50°.

Nueces County: New pay at So. Clara Driscoll—Texas Co. 5 Hattie E. Flinn, Jose A. Cabosos Sur., A-63, Geo. H. Paul Subd. of Driscoll Ranch, TD 6,505 ft., perf. 4,832-39 ft., 129 bbl. oil per day, 12/64-in. choke, gravity 32°.

SOUTHWEST TEXAS (DISTRICTS 1 AND 4) WILDCAT FAILURES

Bastrop County: E. R. Marts 1 H. L. Bartlett, Martin Wells Sur., 1 mi. SW Elgin, dry, TD 2,212 ft.

Caldwell County: B & S Drilling Co. 1 Tyre H. Brown, B. G. Redens Sur., 2 mi. W McMahon, dry, TD 2,800 ft.

Duval County: Grubb and Hawkins 1 J. M. Bennett, Hinojosa Gr., 5½ mi. N-NW Realitos, dry, TD 5,016 ft.

Travis County: Anderson Prichard Oil Corp. 1 Joe A. Martin est., Michael Green Sur., 1 mi. E Elroy, dry, TD 815 ft.

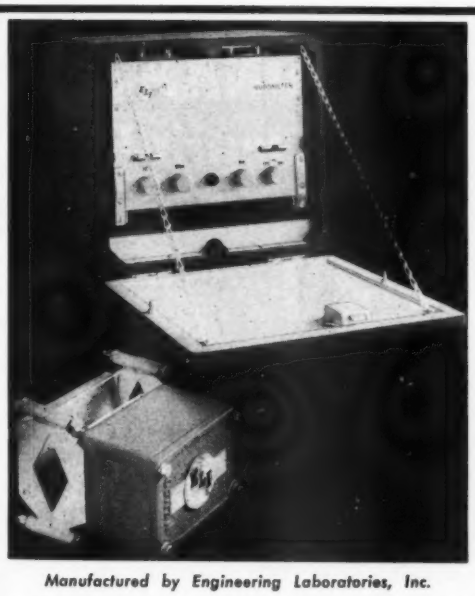
Appalachian Field

Maryland Wildcat Tests Good Shallow Gas Blow

PITTSBURGH.—In Garrett County, Maryland, Columbian Carbon Co. 1-1502 N. K. Welch is drilling at 2,865 ft. in a limy shale formation. Gas was encountered at 2,846 ft., originally testing 2,017,000 cu. ft., which blew down to 1,884,000 cu. ft. In further drilling, more gas was encountered and the test at this time is 2,900,000 cu. ft. Other wells in this area that remain shut down are Eberly & Snee 1 George H. Blocher, depth 5,136 ft., and Fox & Trimble 1 Edward Kite, depth 5,019 ft.

In Leidy Township, Clinton County, Pennsylvania, New York State Natural Gas Corp. has made three locations: N-2-195 Earle H. Connell, elevation 1,358 ft.; N-1-196 Mabel G. Calhoun, elevation 924 ft.; N-1-197 George W. Cross, elevation 1,065 ft. These wells are on the Hammersley Fork Quadrangle. In Noyes Township, Art Kelly Drilling Co. has located 1 Grant Stout, a rank wildcat on the Renova East Quadrangle.

In Portland district, Preston County, West Virginia, William E. Snee 3 Cora E. Lewis, elevation 2,089 ft., topped the Oriskany sand at 5,348 ft., had gas at 5,348-02 ft. (testing 1,300,000 cu. ft.), and is drilling at 5,402 ft. In Steele district, Wood County, Columbian Carbon Co. 1-GW-1154 H. C. McPherson et al resulted in 10,913,000 cu. ft. of gas, natural (see wildcat paragraph following). Operations have been started at two new wells located on the Belleville Quadrange: Hope Natural Gas Co. 9471 Maggie Ludwig, elevation 728 ft., .20 mile south of Lat. 39°, .05′ and 2.85 miles west



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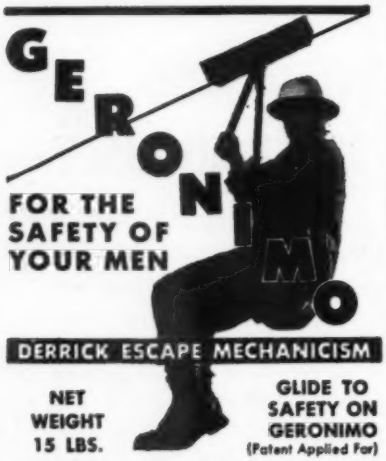
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WEST VIRGINIA SUCCESSFUL WILDCAT

Wood County, Steele district: Columbian Carbon Co. 1-GW-1154 H. C. McPherson et al, elev. 891 ft., 10,913,000 cu. ft. of gas, natural, Corniferous lime 4,978 ft., Oriskany 5,086 ft., gas 5,087-5,100 ft., TD 5,100 ft.

North Central Texas

Cooke County Gets New Strawn Strike

WICHITA FALLS.—Sussex Oil Co. gave west-central Cooke County a relatively prolific shallow Strawn sand discovery, while two tests in the area were abandoned.

The new producer is Sussex 1 A. E. Leslie, located 6 miles northeast of St. Jo in the John English Survey. The well completed flowing 139 bbl. of 40°-gravity oil in 12 hours through 17/64-in. choke, and was given a calculated daily potential of 278 bbl. of oil a day. Pay section was 2,406-20 ft.

The two failures were E. C. Johnston 1 A. Fuhrman, north of the town of Lindsay, which was dry at 2,170 ft., and the same operator's 1 Hacker, 1½ miles south of Lindsay, dry at 1,860 ft.

Field sources hinted at the possibility of a Canyon reef discovery in eastern Baylor County, 8 miles northeast of the town of Seymour, as J. J. Lynn 2 Lucy Jones, T&NO Survey, drilled limestone showing oil from 2,536-3,539 ft. Casing was set at 2,539 ft., 3 ft. below top of the reef, for completion, with no preliminary tests made.

Flowing oil on a drill-stem test in the Mississippian gave eastern Baylor County another hit at Helmerich & Payne, Inc. 1 Hardison, located 3 miles northeast of Rendham field and 14 miles east of Seymour. Length of the test, from 5,297-5,314 ft., was not reported, but gas surfaced in 17 minutes and flowing oil in 24 minutes. No estimate was made on recovery. Operators started setting casing for completion. The new prospect is 3½ miles southeast of Caddo production recently opened by J. J. Lynn of Wichita Falls on the southeast flank of a Canyon limestone area.

Throckmorton County had prospects of new Strawn sand production at Bridwell Oil Co. 1 M. A. Tuttle, 6½ miles northeast of Woodson, and new Mississippian oil at Warren Oil Corp. 1 Matthews Unit, 5 miles southeast of Woodson. The 1 Tuttle drill-stem tested from 3,196-3,205 ft. and had gas to the surface in 11 minutes. Recovery was 1,120 ft. of clean oil, 140 ft. of oil-cut mud and 150 ft. of salt water in 1½ hours. Drilling continued below 3,317 ft., to test the Caddo lime. Warren's 1 Matthews perforated in open hole from 4,405-15 ft., ran tubing and prepared to swab. A previous drill-stem test recovered 3,390 ft. of oil in 2 hours, from the above section.

NORTH CENTRAL TEXAS (DISTRICTS 9 AND 7-B) SUCCESSFUL WILDCATS

Coleman County: French M. Robertson 1 A. E. Jones, 16-2-T&NO, 3½ mi. SE Novice, TD 3,445 ft., elev. 2,109 ft., top Jennings sand 3,431 ft., pay 3,435 ft., IP flowed 87 bbl. 43°-gravity oil a day, 21/64-in. choke, GOR 500 cu. ft., TP 200 psi.

Jack County: Newman Bros. Drilling Co. et al 1 Mildred Durham, G. W. Davis Sur., A-178, 12 mi. E Jacksboro, TD 5,777 ft., gas pay 5,390 ft., IP 1,200,000 cu. ft. a day, TP 264-384 psi.

Jones County: DeSoto Oil Co. 1 G. Bullard, Sec. 2, GC&SF Sur., 2 mi. SW Anson, TD 4,688 ft., elev. 1,771 ft., Flippen 2,484

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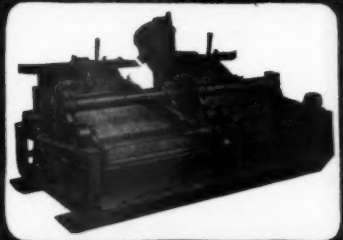
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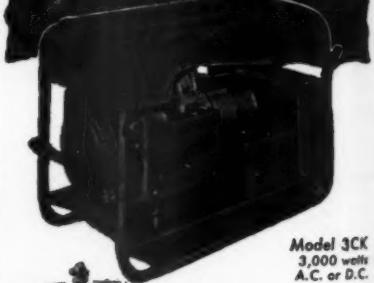
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ft., pay 2,491 ft., IP pumped 108.5 bbl. 37°-gravity oil a day.

J. M. Mitchell 1 M. H. Goode, 43-18-T&P, 1½ mi. SE Noodle, TD 4,716 ft., elev. 1,828 ft., pay 4,706 ft., IP flowed 155 bbl. 43°-gravity oil a day, 16/64-in. choke, GOR 500 cu. ft., CP 575 psi., TP 375 psi.

Knox County: Sinclair Oil & Gas Co. 1 G. H. Beavers, 224-44-H&TC, 3 mi. N Benjamin, TD 6,400 ft., Caddo 5,746 ft., Ellenburger 6,359 ft., perforated 5,920-30 ft., IP pumped 84 bbl. 42°-gravity oil a day.

Montague County: Midland Oil Corp. 1 G. H. Guerin, R. H. Grimes Sur., 5 mi. N St. Jo, TD 2,498 ft., Strawn sand pay 2,461 ft., IP pumped 54 bbl. 43°-gravity oil a day.

NORTH CENTRAL TEXAS (DISTRICTS 9 AND 7-B) WILDCAT FAILURES

Brown County: P. M. Barton 1 Smoot Heirs, A. Scott Sur., 4 mi. W Williams, dry, TD 2,150 ft., elev. 1,490 ft., Caddo 1,945 ft.

Houston Oil Co. of Texas 1 Denman Kountze, Sec. 5, ETRR Sur., 4 mi. SE May, dry, TD 3,248 ft., elev. 1,934 ft., Ellenburger 3,171 ft.

Trumpter Oil Co. 1 J. M. Nichols, Sec. 50, HT&B Sur., A-1310, 2½ mi. SW Byrd's Store, dry, TD 2,470 ft., Caddo 1,788 ft., Marble Falls 2,384 ft.

Callahan County: George Joeris 1 G. L. Pate, Sec. 59, BBB&C Sur., 3 mi. NW Clyde, dry, TD 1,568 ft. in sand.

W. W. Sawyers 1 Robert Buchanan, Sec. 8, BOH Sur., 2 mi. SE Putnam, dry, TD 502 ft.

Clay County: Anderson Drilling Co. 1 Stine Estate, Bacon Subd., Blk. 63, 3 mi. SW Petrolia, dry, TD 1,852 ft.

Coleman County: R. W. McKessick 1 Carrie Harlee, Sec. 1, HT&B Sur., ½ mi. E Rock Crusher, dry, TD 2,305 ft., elev. 1,855 ft., Home Creek 2,125 ft.

J. D. Stubblefield 1 L. O. Garrett, Blk. 76, G. W. Mahoney Sur., 5 mi. SW Santa Anna, dry, TD 2,540 ft., elev. 1,565 ft., Caddo 2,118 ft.

United North & South Development Co. 1-A L. L. Shield, GH&H Sur. 3, 3 mi. W Santa Anna, dry, TD 695 ft.

Eastland County: Scott L. Taliaferro 1 A. A. Huntington, W. H. Burgess Sur., 4 mi. NE Pioneer, dry, TD 2,690 ft., Caddo 2,612 ft.

Haskell County: T. D. Humphrey 1 Albert Klose, S. W. Lawrence Sur., A-737, 15 mi. E Haskell, dry, TD 5,406 ft., elev. 1,487 ft., Caddo 4,937 ft., Mississippian 5,224 ft.

Sojourner Drilling Co. 1 W. F. Linderman, 25-1-H&TC, 3 mi. SW Haskell, dry, TD 5,645 ft., elev. 1,561 ft., Caddo 5,435 ft.

Jones County: Farris Oil Co. 1 J. H. Fry, Sec. 103, BBB&C Sur., 2½ mi. SW Tuxedo, dry, TD 3,215 ft., elev. 1,671 ft., Flippen 2,601 ft., Hope 2,745 ft.

Montague County: Mid-Continent Petroleum Corp. 1 Upton Harbert "A," E. Wingate Sur., A-835, dry, TD 6,715 ft., elev. 1,080 ft., Caddo 6,190 ft., conglomerate 6,442 ft.

Nolan County: Texas Pacific Coal & Oil Co. 1 W. H. Bennett, Acct. 1, 31-20-T&P, 8 mi. ESE Sweetwater, dry, TD 6,281 ft., elev. 2,147 ft., Caddo 5,868 ft., Ellenburger 6,135 ft.

Taylor County: Humble Oil & Refining Co. 1 Henry Sayles, Jr., John Trussell Sur. 141, 9 mi. SW Buffalo Gap, dry, TD 5,605 ft., elev. 2,325 ft., Noodle Creek 2,528 ft., Flippen 2,814 ft., Palo Pinto 3,800 ft.

William Perlman 1 Jesse Brown, 29-17-T&P, 3 mi. NE Tyre, TD 2,670 ft., elev. 1,755 ft., Dotham 1,835 ft., Saddle Creek 2,212 ft., Flippen 2,236 ft., Lower Hope 2,461 ft., King 2,569 ft., Swastika 2,132 ft.

Throckmorton County: A. G. Hill 1 N. L. B. Davis, Sec. 2,314, TE&L Sur., 9 mi. NE Woodson, dry, TD 4,764 ft., elev. 1,271 ft., Caddo 3,963 ft.

Oltex Drilling Co. 1 N. L. B. Davis, Blk. 1, J. Pointevent Sur., A-242, 4 mi. N Elbert, dry, TD 1,281 ft.

Young County: C. G. Butts 1 L. Smith, Sec.

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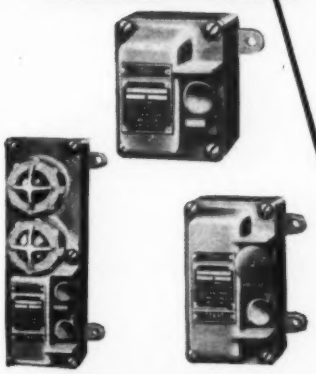

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Eastern Texas

Forest Hills Extension Try Sets Casing, Perforates

DALLAS.—Edson Petroleum Co.'s 1 J. L. Jacobs, prospective sub-Clarksville sand discovery in northern Wood County, had casing set at 4,587 ft. and perforated from 4,528-50 ft. for completion tests. Location is 3 miles northeast of the 1 J. E. Brown, discovery well of Forrest Hills sub-Clarksville field, and operators believed the two wells to be on the same fault. If so, the new well would extend production 2½ miles.

Production string was also being run for completion attempt at Union Producing Co. 1 W. O. Prestidge, in North Jacksonville gas field of Cherokee County. The well failed to find the regular gas zone in drilling to 4,529 ft. but two drill-stem tests in the Woodbine sand indicated an oil discovery for the field. A 30-minute test from 4,451-56 ft. recovered 800 ft. of 39°-gravity oil, 10 ft. of oil-cut mud and 10 ft. of salty water. A second 30-minute test from 4,456-59 ft. recovered 125 ft. of oil plus 10 ft. of oil-cut mud and 15 ft. of salt water.

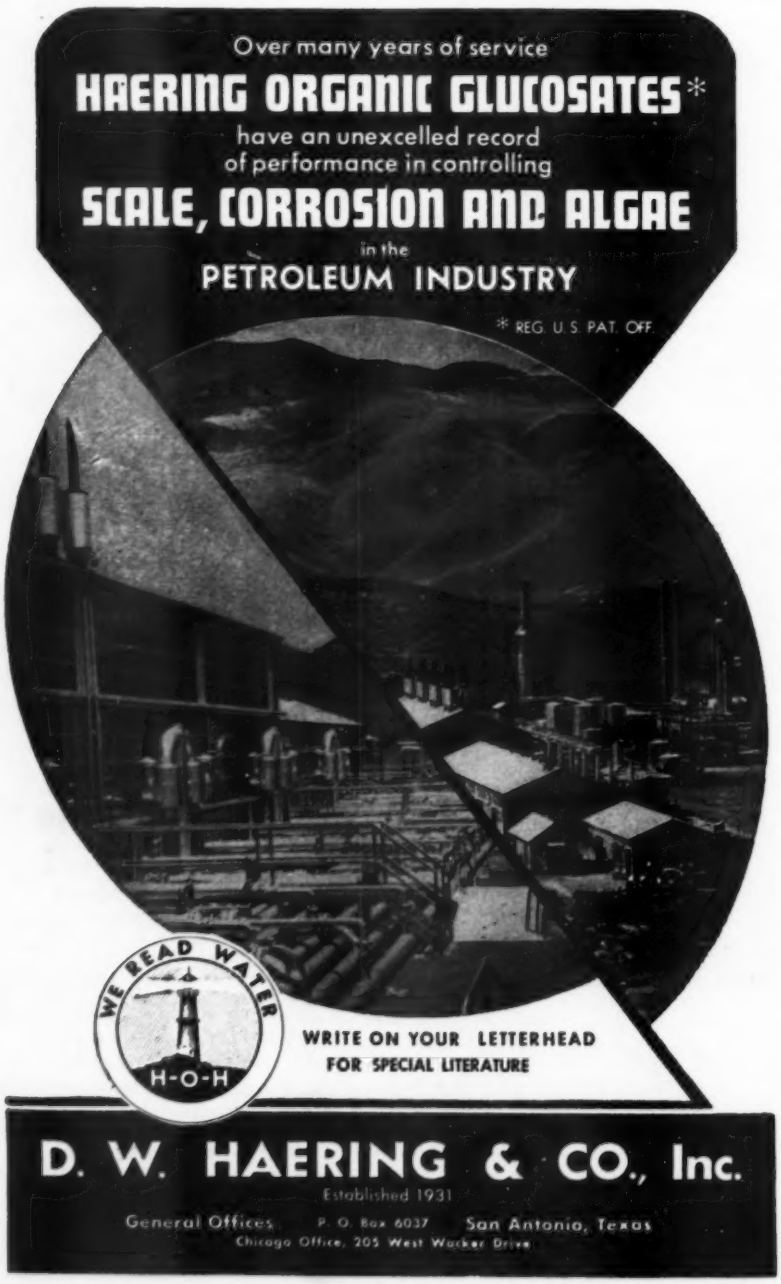
South of Tennessee Colony field of Anderson County, Continental Oil Co. 2 Royall National Bank stopped drilling at 9,820 ft. in sand with no shows, tentatively identified as the Travis Peak, and was setting casing to 9,694 ft. for tests in the Pettit. The latter section showed for discovery production on a drill-stem test at 9,612-44 ft.

EAST TEXAS (DISTRICTS 5, 6 AND 6-P) SUCCESSFUL WILDCAT

Freestone County: Humble Oil & Refining Co. 1 Freestone, Unit 1, J. L. Chavert Sur., A-10, 2.8 mi. NW Donnie, TD 8,505 ft., perforated 8,234-8,360 ft., IP 2,100,000 cu. ft. gas a day, open flow, plus 15 bbl. distillate.

EAST TEXAS (DISTRICTS 5, 6 AND 6-P) WILDCAT FAILURE

Henderson County: Humble Oil & Refining Co. 1 Jewel Burford, D. O. Williams Sur., 6 mi. SW Mabank, dry, TD 6,805 ft., elev. 362 ft., Austin chalk 2,600-3,176 ft., Woodbine sand 3,618 ft. by samples.



California

Los Angeles County Wildcat Setting Pump

LOS ANGELES.—Pumping equipment is being installed on a wildcat in the Aliso-San Fernando area of Los Angeles County. The wildcat, Los Nietos Co. 1 Edwards in Section 1-2n-16w, is located about 3 miles southeast of production in Aliso Canyon field.

First drilled to a total depth of 5,722 ft., then whipstocked and redrilled to 4,036 ft. and plugged back to 3,920 ft., the test has been a "no-dope" hole. Reports on the well, however, credited it with picking up a thin sand section in the first hole and a thicker section in the redrilled hole. Water difficulty was encountered but has been successfully cemented off. General thought is that the wildcat will result in a small pumper.

The scheduled 14,000-ft. test of deep horizons in Elk Hills field of San Joaquin Valley apparently has found substantial gas production in the Oligocene. On a drill-stem test at about 6,000 ft. a gas blow estimated at the rate of over 7,500 M.c.f. daily was reported. The test, Standard Oil of California X-55 in the Naval petroleum reserve, is located in Section 30-30s-23e.

In Cuyama Valley a wildcat which will be watched closely was staked by Richfield Oil Corp. It will be drilled in Section 7-10n-27w, or about 1 mile southwest of oil production in Russell Ranch field. It has been designated its 77 Russell. In the southeastern end of the valley Honolulu Oil Corp. was reported coring and drilling below 6,240 ft. at its 1 Honolulu-Oceanic.

In the Reyes Peak area of Ventura County, Standard Oil of California was rigging rotary on its rank wildcat after building some 8½ miles of all-weather road and leveling a mountain peak to provide a level site for the deep test. Designated its 1 Hattie Russell and located in Section 11-6n-23w, the wildcat is some 32 miles southeast of South Cuyama field and more than 13 miles from nearest production in the Ojai district. Nearest wildcat ever drilled is the currently drilling Superior Oil Co. 65-20 Smith, near Ozena some 6 miles to the northwest.

CALIFORNIA WILDCAT FAILURES

Fresno County, Coalinga area: Atlantic Oil Co. 331-25T, 25-19s-14e, dry, TD 6,986 ft., elev. 1,502 ft.

Kern County, Gosford area: Superior Oil Co. 52-24 Edgar, 24-30s-26e, dry, TD 8,002 ft., elev. 361 ft.

Round Mountain-Sharktooth area: Macmillan Petroleum Co. 1 Bishop Comm., 24-28s-28e, dry, Vedder 2,373 ft., TD 2,384 ft., elev. 967 ft.

Tejon Hills area: Barney-Cornett & Assoc. G-1 Barney Cornett & Assoc., 10-11n-18w, dry, sand 485 ft., TD 548 ft., elev. 1,231 ft.

San Benito County, Vallecitos-Panoche Hills area: Paull, W. R. and Assoc. 1 Rowell

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San Luis Obispo County, Paso Robles-Templeton area: A. S. Mayes 2 Cook, 26-27s-12e, dry, TD 2,003 ft.

San Mateo County, Butano Ridge area: Texas Co. 1 Blomquist, 4-8s-4w, dry, TD 4,957 ft., elev. 1,070 ft.

Ventura County, Cuyama Valley (Ventucopa) area: Richfield Oil Corp. 2 Apache unit, 30-8n-23w, dry, TD 3,404 ft., elev. 3,896 ft.

Permian Basin

Midland County Wildcat Taps Pennsylvanian Oil

MIDLAND.—Magnolia Petroleum Co. 1 H. F. Timmerman, Midland County wildcat, had established a new Pennsylvanian oil pool, or a long south and east trend to the Parks Pennsylvanian and Ellenburger discovery. On elevation of 2,851 ft., the 1 Timmerman drilled into the Pennsylvanian at 10,449 ft., or 38 ft. low on that formation correlated with Magnolia's 2 Parks well. The Parks discovery drilled about 250 ft. into the Pennsylvanian before finding oil but the Timmerman test developed flowing oil on a drill-stem test from 10,445-10,535 ft. Using ⅝-in. bottom-hole choke, gas surfaced in 4 minutes, mud in 25 minutes and oil in 30 minutes. It was allowed to flow into pits for 14 minutes before being turned into tanks, where it gaged 41.4 bbl. of 43.5°-gravity oil in 90 minutes. Gas-oil ratio was 1,849 cu. ft. Operators were drilling ahead on an Ellenburger contract.

Ten miles south of Tex Harvey Spraberry field, Humble Oil & Refining Co. 1 T. O. Midkiff, treated the Spraberry sand zone with Hydrafrac at 7,451-7,520 ft. and swabbed approximately 10 bbl. of oil, cut with salt water, in 24 hours.

In southwestern Kent County, Drilling & Exploration Co. 1 D. Wilson Connell reported salt water in the Mississippian limestone. The well had been drilled to 8,010 ft., had top of the Ellenburger at 7,850 ft., minus 5,520 ft., but apparently did not test that formation. Final drill-stem test was in the Mississippian at 7,633-7,714 ft. This failure will be a defining factor on the northwest side of East Polar field.

Star Oil Co. 1 Mrs. Blanche Young, southwestern Kent wildcat almost on the Garza County line, recovered 145 ft. of oil and gas-cut mud, plus some salt water, on a drill-stem test from 7,514-67 ft. The section had not been identified and operators were drilling ahead to the Ellenburger.

A second producers was added to Adair Deep field of southern Terry County by Amerada Petroleum Corp. at its 2 N. W. Willard, which completed for 912 bbl. of 43°-gravity oil. Plugged back total depth was 8,563 ft. The new well is a west offset to the same operator's 1 Willard, discovery for the area, and which was drilling ahead below 12,237 ft. in lime and chert.

Gulf Oil Corp. 1-E-B G. W. Glass, Martin County deep test, was plugged back to 10,787 ft. from total depth of 12,915 ft. in lime. Operators ran tubing to 10,780 ft. and swabbed 60 bbl. of water in 8 hours. The well then kicked off and flowed water with a light show of oil for 2 hours and died.

Five miles southeast of Winters in Runnels County, casing had been set at John A. Messenger 1 Nora May Jones, Gardner sand discovery. The well was assured of flush production from a section at 4,078-89 ft., which, on 30-minute test, had flowing oil in 8 minutes at an estimated rate of 10 bbl. an hour. Recovery in the drill pipe was 450 ft. of oil.

Further testing in the Simpson (middle Ordovician) has been scheduled at Sinclair Oil & Gas Co. 1 Lips, Mississippian discovery of Lips field of northern Roberts

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County, Texas Panhandle. Operators were using a diamond-core bit, and were reported to be 25 ft. in the Simpson at 10,404 ft. where a drill-stem test was to be run. Original completion of the well was for 420 bbl. of oil a day from the Mississippian at 8,900-70 ft. Production was said to have decline to around 20-30 bbl. a day, on the pump, when operators decided to test the deeper formations.

WEST TEXAS (DISTRICTS 8 AND 7-C) SUCCESSFUL WILDCAT

Martin County: The Texas Co. 1-X State, 17-7-University Lands, 12 mi. N Mabee field, TD 13,420 ft., PB 13,324 ft., elev. 2,944 ft., Ellenburger 13,260 ft., pay 13,275 ft., perforated 13,275-300 ft., IP pumped 14 bbl. 48°-gravity oil a day.

WEST TEXAS (DISTRICTS 8 AND 7-C) WILDCAT FAILURES

Borden County: Fair-Parker-McCune 1 T. L. Griffin, 46-25-H&TC, TD 7,879 ft., elev. 2,365 ft., reef top 7,196 ft.

Ector County: Anderson Prichard Oil Corp. 1 Fasken C-31, 31-42-G&MMB&A, 2 mi. E North Cowden field, dry, TD 4,920 ft., elev. 3,027 ft., Yates 3,060 ft., Grayburg 4,670 ft.

Garza County: John B. Collier 1 P. G. Spining Estte "G," 937-97-H&TC, ¾ mi. N Rocker A field, dry, TD 2,731 ft., elev. 2,287 ft., San Andres 2,095 ft.

Kent County: General American Oil Co. 1 Atkins Estate, 86-G-W&NW, 3 mi. SW Salt Creek field, dry, TD 9,136 ft., elev. 2,255 ft., reef 6,865 ft.

Lynn County: M. F. C. Corp. 1 Garza Land & Cattle Co., 10-10-ELRR, 3½ mi. S Magnolia reef discovery, dry, TD 8,715 ft., elev. 2,869 ft., reef 8,628 ft.

McCulloch County: J. R. Sterrett 1 N. V. Hodges, H&GC Sur. 163, 4 mi. N Brady, dry, TD 805 ft. in dolomite, Ellenburger 800 ft.

Midland County: Trebol Oil Co. and Rodman 1-SA Josie Faye Peck, 20-41-T4S-T&P, dry, TD 5,347 ft., elev. 2,902 ft.

Pecos County: Hunt Oil Co. 23 Elsinore Royalty Co., 37-G-GC&SF, 7 mi. SE Chancellor, dry, TD 2,290 ft. in lime.

Reeves County: E. L. Fitch & J. V. Massey 1 State-R. D. Compson, 46-56-T2-T&P, 5 mi. S Tunstill field, dry, TD 3,765 ft., elev. 2,851 ft., Delaware sand 3,336 ft.

Geo-Chemical Surveys, Inc. and Intex Oil Co. 1 H. C. Mandell, 15-4-H&GN, 8 mi. N Pecos, dry, TD 4,505 ft., elev. 2,608 ft., Delaware lime 4,353 ft.

Gulf Oil Corp. 1 TXL "CS," 1-51-T8-T&P, dry, TD 5,297 ft., elev. 2,722 ft., Delaware lime 5,062 ft.

Runnels County: United North & South Development Co. 1 W. B. Dennis and Ruth King, ETRR Sur. 123, 12 mi. E Winters, dry, TD 4,100 ft.

Schleicher County: Plymouth Oil Co. 1 Thomerson, 66-H-GH&SA, dry, TD 5,866 ft., elev. 2,418 ft., Canyon lime 4,560 ft., Strawn 5,322 ft., Ellenburger 5,836 ft.

Tom Green County: Danciger Oil & Refining Co. and American Republics Corp. 1 Susan Easterwood, Carl Ziehen Sur. 896, 12 mi. W Susan Peak field, dry, TD 6,304 ft., elev. 2,014 ft., Palo Pinto 4,835 ft., Ellenburger 6,278 ft.

Upton County: Morty Freedman 1-A C. W. Hobbs, 36-35-H&TC, 36-35-H&TC, 5 mi. NW McCamey, dry, TD 5,600 ft., elev. 2,527 ft., Clear Fork 3,070 ft.

SOUTHEASTERN NEW MEXICO

HOBBS.—McAlester Fuel Co. 1-A Brownfield, Lea County wildcat 10 miles east of Tatum, found water and oil in the lower Devonian at 12,004-12 ft., and prepared to test higher in the formation through perforations at 11,785-11,840 ft.

Located in 24-12s-37e, this prospective Devonian discovery 15 miles north of Denton field, prepared to plug back to 11,995 ft. from total depth of 12,035 ft. in dolomite. After treating with acid at total depth, recovery on the swab was 100 per cent water. Top on the Devonian was 11,790 ft., or minus 7,908 ft.

Two miles north of Denton field, Ralph Lowe 1 Dickinson, 35-14s-37e, was drilling ahead at 10,991 ft. following a test from 10,820-875 ft., in the Pennsylvanian, which recovered 1,200 ft. of oil and gas emulsion, plus 460 ft. of oil and gas-cut salt water. Length on the test was 5 hours.

SOUTHEAST NEW MEXICO WILDCAT FAILURE

Eddy County: Allen Hargrave 1 Hanks, SE SE NW 3-26s-27e, dry, TD 2,302 ft., Delaware lime 2,025 ft., sand 2,085 ft.

Louisiana-Arkansas

Caddo Parish Wildcat Continues Testing

SHREVEPORT.—Skelly Oil Co. 1 Williamson, 9-19n-16w, Caddo Parish wildcat, stopped at 5,552 ft., still in the Pettit limestone, and prepared to run additional drill-stem tests. First test, in the Hill zone, from 4,708-35 ft. was open 1 hour and recovered salt water. A 1-hour test at 5,477-5,517 ft., in the Pettit, recovered 30 ft. of mud.

Ray & Woolf 1 English, 8-21n-5w, Claiborne Parish, was waiting on orders at 5,820 ft., following a drill-stem test at 5,548-86 ft., in the Travis Peak, which recovered 4,000 ft. of salt water in 20 minutes.

In DeSoto Parish, Lyons, Prentiss & McCord 1 Sue Chaffin, 4-12n-14w, was drilling ahead at 3,250 ft. Cores from 2,778-2,828 ft. recovered chalky lime with faint gas odor, and from 2,928-68 ft. recovery was fossiliferous lime and shale with faint oil odor.

NORTH LOUISIANA SUCCESSFUL WILDCAT

Bienville Parish: E. C. Cook 1 W. C. Locke, 9-15n-10w, TD 2,802 ft., elev. 185 ft.,

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Paluxy sand 2,790-96 ft., completed in open hole 2,782-2,802 ft., IP flowed 68.4 bbl. 41.7°-gravity oil a day, TP 75 psi., CP 295 psi., GOR 915 cu. ft.

NORTH LOUISIANA WILDCAT FAILURES

Catahoula Parish: Hunt Oil Co. 28 Louisiana Delta, SE SE 30-4n-5e, dry, TD 7,500 ft., elev. 52 ft., Wilcox 4,548 ft., Wilcox sand 6,278-83 ft.

Claiborne Parish: Stanoland Oil & Gas Co. 1 G. W. Meadors, NE NW 8-22n-5w, dry, TD 11,705 ft., elev. 267 ft., salt top 11,683 ft.

Concordia Parish: Kemp Drilling et al 1 K. S. Minor estate, 8-7n-10e, dry, TD 7,013 ft.

Union Parish: Southwest Gas Production Co. 1 C. C. Colvin, 8-21n-2w, dry, TD 7,808 ft.

ARKANSAS SUCCESSFUL WILDCAT

Union County: Pan-Am Southern Corp. 1 Tucker, SE SW NE 8-18s-13w, TD 4,008 ft., PB 2,653 ft., perforated Meakin 2,544-52 ft., IP pumped 8 bbl. oil.

Rocky Mountain

General Petroleum Opens Big Embar Pool in Wyoming

DENVER.—A new discovery for the east side of Big Horn basin, Wyoming, has been made with flow gages of General Petroleum Corp.'s wildcat in the Slick Creek area, 10 miles south of production in Worland field. The well is 84-32-G, SE SE NE 32-47n-92w, and a 2½-hour test of the Embar formation flowed 50 bbl. of oil per hour. Embar was topped at 10,464 ft. and the well was drilled to 10,564 ft., total depth. Casing was cemented on top of the formation and when plug was drilled, the operator swabbed until the well started flowing. General Petroleum had cored excellent saturation in the Embar lime, but had made no previous tests of the zone. Apparently the well will open a sizable reserve in the Embar formation. At Worland, where Embar production was established in 1946, Pure Oil Co. as operator of the unit now has 20 wells completed in that formation with curtailed production over 5,000 bbl. daily. General Petroleum has conducted an exploratory drilling campaign through this area for the past 4 years, since doing extensive seismic work in the area. As a result, production has been established in the Frontier sands at Sand Creek, 12 miles southeast, as well as Embar production at South Fork, 10 miles south, and South Frisby, 4 miles northeast of the new Slick Creek producer. Producing problems have been encountered in Embar formation wells in the Worland area due to high carbon dioxide content of the gas, but at South Fork the oil is low gravity with sweet gas. An analysis of the production at Slick Creek has not been made.

Location has been made by Shell Oil Co. in the North Sterling area, Colorado, for 1 Green, SW NW NW 3-9n-53w, continuing the company's wildcat program through the Denver-Julesburg basin. The operator will move its own tools in for the well. This wildcat is in the area where British-American Oil Producing Co. is now nearing completion on a wildcat in the NW NE SE 20-9n-53w. This well was drilled into the Morrison and has been plugged back to the first Graneros sand where casing was perforated for testing in that zone. The well made only 10 bbl. per day on swabbing test, and the operator plans to employ the Hydrafrac treatment on the zone. Shell Oil Co. is also planning the same treatment at its discovery in the Muddy sand in the Buckingham area, at 1 Hansen, NE NE NE 33-8n-59w, Weld County. This well was drilled into the Morrison and plugged back for completion between 6,710-22 ft. It flowed on drill-stem test of that zone but after perforating casing the well has made only 41 bbl. of oil daily.

In Utah General Petroleum Corp. announced location for an important wildcat in the San Rafael River area, Emery County. This well be a deep test for the west side of the so-called Salt basin of Utah and Colorado. In the Lucerne area, Hot Springs County, British-American Oil Producing Co. has spudded a 3,000-ft. Tensleep test at 1 Melton, SW SW NW 5-43n-94w. Amerada Petroleum Corp. has made location for a test to granite in the Muddy Creak area at 1 Universal-Sterling, SE SE NW 21-26n-80w, Carbon County.

COLORADO SUCCESSFUL WILDCAT

Armstrong, Logan County: British-American and Plains Exploration Co. 1 Kelly P. Linde, NE SE SE 23-11n-53w, TD 5,647 ft., 16,000,000 cu. ft. gas daily, 5½-in. casing 5,330 ft., Niobrara 4,414 ft., "D" sand 5,232 ft., "J sand 5,350 ft., "O" sand 5,603 ft., jet perf. 128 holes 5,256-74 ft.

COLORADO WILDCAT FAILURES

Pueblo County: H. A. Hardy 1 Crow, NE NE SW 30-24s-66w, TD 600 ft., dry.

Burroughs Dome, Routt County: W. E. Atkinson 2 State, SW NE SE 14-6n-85w, TD 769 ft., dry.

Harrisburg, Washington County: Carter Oil Co. 1 A. E. Sheetz, SE SE SW 11-3s-51w, TD 4,600 ft., dry, Niobrara 3,005 ft., Timpas 3,452 ft., Codell 3,510 ft., first sand 3,933 ft., second sand 3,987 ft., Lakota 4,288 ft., Morrison 4,383 ft.

Woodrow, Washington County: Adams Drilling Co. and Woodrow Syndicate 1 State, C SE NE 16-1s-55w, TD 5,402 ft., dry, Hygiene 2,189 ft., Niobrara 3,975 ft., Timpas 4,370 ft., first Muddy 4,847 ft., second Muddy 4,913 ft., first Dakota 4,940 ft., second Dakota 5,009 ft., Fuson 5,042 ft., Lakota 5,185 ft.

MONTANA WILDCAT FAILURE

North Lake Basin, Stillwater County: Superior Oil Co. 71-22 Couplos, NW NE NE 22-2n-21e, TD 4,944 ft., dry, Claggett 680 ft., Eagle 960 ft., Colorado 1,220 ft., basal Dakota siltstone 3,720-26 ft., Fuson 3,726 ft., Lakota 3,904 ft., Morrison 3,957 ft., Ellis 4,209 ft., Amsden 4,629 ft., Madison 4,903 ft.

NEBRASKA WILDCAT FAILURES

Weyerts area, Cheyenne County: Jack Dunbar 1 Juergens, NE NW NE 1-15n-48w, TD 4,495 ft., dry, Niobrara 3,473 ft., Greenhorn 4,018 ft., first sand 4,253 ft., "G" sand 4,303 ft., "J" sand 4,380 ft.

Rushville area, Dawes County: Ohio Oil Co. 1 Dotson, SE SE SE 9-30n-47w, TD

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2,428 ft., dry, Skull Creek 1,640 ft., Cloverly 1,845 ft., Morrison 2,082 ft.

Murphy area, Morrill County: British-American Oil Producing Co. 1 Worth, NW NW NW 9-17n-51w, TD 5,508 ft., dry, Niobrara 4,020 ft., Ft. Hayes 4,279 ft., Greenhorn 4,575 ft., "D" sand 4,862 ft., "J" sand 5,008 ft., Cloverly ("M" sand) 5,190 ft., "O" sand 5,268 ft., "R" sand 5,338 ft., "T" sand 5,412 ft., Morrison 5,500 (?) ft.

SOUTH DAKOTA WILDCAT FAILURES

Butte County: Tee Pee Buttes Oil Co. 2 Hafnie, C SW NE 33-9n-7e, TD 2,752 ft., dry, Niobrara 1,055 ft., Greenhorn 1,600 ft., Muddy 2,309 ft., Dakota 2,631 ft.

Boxelder Trend, Meade County: Morton Oil and Amerada 1 Snyder, SE SE SE 20-5n-9e, TD 2,420 ft., dry, Muddy 2,083 ft., Dakota 3,346 ft.

Belle Fourche River area, Meade County: Morton Oil and Amerada 1 Bartelsen, NW NW NW 9-2n-9e, TD 2,408 ft., dry, Muddy 2,078 ft., Dakota 2,386 ft.

Morton Oil and Amerada 1 Lewis Carlson, SE SE NW 20-5n-8e, TD 2,134 ft., dry, Muddy 1,718 ft., Dakota 1,990 ft.

Canadian Fields

Texaco, McColl-Frontenac Get First Alberta Strike

CALGARY.—A new oil-bearing Devonian D3 reef was discovered at South Calmar this week, and the Lower Cretaceous sands became a better oil objective above the Devonian reefs of Acheson and North Woodbend. Meanwhile, oil potentials were established for recent Devonian oil discovery wells at Big Valley, Camrose, and Acheson, and discovering companies launched new drilling to speed evaluation of the finds.

This week again brought developments that further boosted enthusiasm for the South Central and Central Alberta Plains and augmented hopes of reaching a 2,000,000,000-bbl. reserve level for the province. Next week Alberta oil will move eastward with opening of the Edmonton-Regina section of the Great Lakes pipe line, and oil will arrive at the lakes by the year's end. Continuing discoveries and growth of reserves insure that the 1,150-mile pipe line marks the beginning of Alberta's oil market expansion objectives.

Texaco Exploration Co. and McColl-Frontenac Oil Co. made their first oil discovery in Alberta, when their Texaco-South Calmar 1 cored into highly porous, oil-bearing D3 Devonian reef at 5,578 ft., and opened 16 ft. of pay zone before reaching water. Test of the pay gas flow of 250,000 cu. ft. daily with 39°-gravity light oil reaching surface 40 minutes after tester opened. D3 was topped 137 ft. lower than water line of D3 reef in Leduc field, whose productive boundary is 4 miles to the northeast. The well also had indications of commercial oil production in D2 zone, whose Leduc field boundary is 2½ miles north.

Central Leduc Oils, Del Rio Oil Producers, and Cohen-Finkelson Group, participants in Central-Del Rio-Acheson 1 wildcat, made this week's other oil find. Their well, 1½ miles northeast of the California - Standard - Imperial Acheson D3 Devonian discovery, brought light crude to the surface in 40 minutes at flow rate of 84 bbl. hourly, flush in drill-stem test 14 ft. in a Lower Cretaceous sand topped at 3,960 ft. The well is continuing on for test of deeper horizons. This discovery had large gas flows and some oil in Lower Cretaceous, while Central Leduc Oil's Wild 1, 3½ miles southwest of the Central-Del Rio test, found commercial volumes of oil in Cretaceous before completing as a D3 Devonian success.

At North Woodbend, where the Anglo Canadian Oil-Home Oil-Calgary & Edmonton Corp.-Imperial Oil team made an important D3 Devonian reef extension recently to Leduc-Woodbend field, current drilling indicates a bright prospect of a Lower Cretaceous oil field. The team's North Woodbend 4 and 5 wells, like previous D3 completions Nos. 1 and 3, have shown Cretaceous sand oil in commercial volume in drill-stem tests. Both wells are heading on for the Devonian completion. The Cretaceous oil will undoubtedly be tapped in the future.

Meanwhile, Socony-Vacuum Exploration Co. has established on its Socony-Flint 1 dual-zone oil discovery near Camrose, and is readying for steady production from D3 reef, plugging off D2 zone for the time being. D3 pay, about 30 ft. thick, showed 1,110 bbl. daily through ½-in. choke. D2, from 30-35 ft. of pay, showed flush of 2,078 bbl. daily through 2-in. line open flow. Oil is 35°-gravity. Socony has commenced its first follow-up well 2 miles northeast of the discovery, and will start a second test shortly some distance east of the discovery. Camrose marks the company's first Alberta oil discovery.

Canadian Gulf Oil Co. has established potential of 972 bbl. daily of 33.6°-gravity oil for D3 zone at its Gulf-Big Valley 7, and will produce from 11 ft. of D3 pay, leaving 39 ft. of D2 discovery pay cased off for time being. D2 indicated about 1,000 bbl. daily on drill-stem tests. Meanwhile drilling has started at first follow-up, ⅜ mile northeast.

Acheson-Province 1 discovery, which rated potential of 1,219 bbl. daily of 36.9°-gravity oil after opening 121 ft. of D3 reef pay, has been placed on production. Meanwhile, ¼-mile west offset is making fast progress below 4,600 ft., with answer expected on D3 zone in about 500 ft. This important discovery and follow up are shared 67 per cent by California-Standard Co. and 33 per cent by Imperial Oil.

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CANADIAN SUCCESSFUL WILDCATS

Gulf-BigValley 7, LSD 7, 10-35-20w4, TD 5,435 ft., 972 bbl. oil daily.

Texaco-General Pete 1-22, LSD 1, 22-56-6w5, TD 3,889 ft., oil from pump production.

Select Oils-Chip Lake 1, LSD 4, 29-52-10w5, TD 6,403 ft., oil well.

Socony-Flint 1, LSD 13, 17-45-21w4, TD 4,787 ft., 1,110 bbl. oil daily.

CANADIAN WILDCAT FAILURE

Pan Western-Etter 1, LSD 1, 21-47-24w4, TD 5,500 ft., dry.

Illinois-Ind.-Ky.

Oil Production Indicated In Two Indiana Wildcats

A NEW Pennsylvanian sand pool appears to have been uncovered in the area 3 miles northeast of Mt. Carmel, Ill., in the extreme southwest corner of Knox County, Indiana. The discovery well, R. L. Rea 1 Steckler, NE NE NW 1-2s-12w, is being put on the pump after swabbing tests in which it produced an estimated 10 to 15 bbl. of oil per hour. Saturation is at 1,426-45 ft. with bottom of the hole still in the sand. No water was indicated.

Some 5½ miles to the southwest in northwestern Gibson County, another wildcat is showing for production in Mansfield (Pennsylvanian) sand. It is Louis Galambos, Trustee, 1 Phillips, SW SW SE 9-3s-13w, which yielded 130 ft. of clean oil in a drill-stem test of that sand at 1,178-86 ft. Tester was open 1 hour. Casing has been run to 1,180 ft. for completion. Location, on the bank of the Wabash River (Illinois line), is about ¾ mile east of several small wells and about 1½ miles east of the main Griffin pool production.

The second good well for the recently opened Fairbanks pool, 4 miles northwest of Shelburn, Sullivan County, Indiana, is in the making at Carter Oil Co. 1 Drake-Anderson, SE NE SE 14-9n-10w, where excellent saturation was found in the Devonian pay zone of the discovery producer. Saturation was logged at 2,114-38 ft. and 2,168-2,225 ft., and in a drill-stem test of the zone, the well flowed clean oil. Tester was open 10 minutes with oil at the surface within 8 minutes. The well is a diagonal northeast offset to the discovery well, Carter Oil Co. 1 Herbert Drake.

Bonnie Heath 1 Ellis, NW NE NE 15-1s-8e, 4 miles northeast of Fairfield and ½ mile from other production in the Mt. Erie sector of the Clay City-Noble Consolidated pool, Wayne County, Illinois, is expected to make a good producer in the Rosiclare section, logged at 3,176-84 ft. In a drill-stem test of the zone, the well flowed gas within 2 minutes and clean oil within 35 minutes after the test was opened. Total depth is 3,201 ft. with casing run to the top of the pay.

ILLINOIS SUCCESSFUL WILDCAT

Clinton County: Ben Hess 1 Sohn, SW NW NE 14-3n-3w, IP 57 bbl., Benoist 1,100-07 ft., TD 1,118 ft.

ILLINOIS WILDCAT FAILURES

Clinton County: H. Luttrell 1 Lawler, SE NW NW 31-3n-1w, dry, TD 1,318 ft.

C. R. Winn 1 Allen, SW NW SE 21-3n-2w, dry, TD 1,214 ft.

Cumberland County: C. M. Hickman 1 Gardner, NE SW NE 36-11n-10e, dry, TD 720 ft.

Gallatin County: G. L. Reasor 1 Weiderhold, SW SE SE 26-9s-9e, dry, TD 1,887 ft.

Hamilton County: Floyd & Henson 1 Leach-Young, NW NW SW 26-3s-7e, dry, TD 3,530 ft.

Lawrence County: George & Wrather 1 Dennison, SE NE NE 5-2n-12w, dry, TD 2,337 ft.

Miami Operators Co. et al., 1 Watts, SE SE NE 6-2n-13w, dry, TD 3,015 ft.

Montgomery County: L. L. Benoist 1 Wilson, SW SE NE 11-7n-4w, dry, TD 887 ft.

Randolph County: George & Wrather 1 Fullerton, E½ NW NE SE 14-4s-5w, dry, TD 2,577 ft.

Wayne County: National Associated Petroleum Co. 1 Burgess, SE SW NW 13-1n-5e, dry, TD 3,121 ft.

INDIANA WILDCAT FAILURES

Marshall County: A. A. Giesen 1 Kaiser, SE SE SE 31-35n-1e, dry, TD 270 ft.

Posey County: Indiana Farm Bureau 1 Orth, NW SW SE 11-7s-12w, dry, TD 2,733 ft.

C. H. Hancock, Jr., 1 Kuebler, SW NE NW 17-6s-12w, dry, TD 1,893 ft.

Sullivan County: F. B. Cline 1 Phegley, SE SW SE 11-6n-10w, dry, TD 1,369 ft.

D. Huddleston 1 Campbell, SE SW SE 16-8n-10w, dry, TD 685 ft.

WESTERN KENTUCKY SUCCESSFUL WILDCATS

Henderson County: George S. Engle 1 Brown, S½ NE SE NW 3-P-25, IP 45 bbl., Benoist 2,020-30 ft., TD 2,190 ft.

R. E. Hupp and associates 1 Pinkston, SEc NW SW SW 2-P-25, IP 296 bbl., McClosky 2,161-74 ft., TD 2,178 ft. (Extension Zion pool.)

WESTERN KENTUCKY WILDCAT FAILURES

Daviess County: National Associated Petroleum Co. 1 Toler, SEc SE SW NE 22-Q-32, dry, TD 1,228 ft.

Hancock County: J. C. Miller 1 Mason, SWc NE SE SW 5-Q-33, dry, TD 3,121 ft.

National Associated Petroleum Co. 1 Williams, SE NE SE 25-R-33, dry, TD 1,481 ft.

Henderson County: H. C. Farmer et al., 1

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G. L. Reasor 1 Mattingly, SWc NW NW SW 20-P-23, dry, TD 2,654 ft.
Union County: F. B. Cline 1 Rudd, E½ NW NE NW 11-N-18, dry, TD 3,134 ft.

EASTERN KENTUCKY

ASHLAND. — In Isonville pool area of eastern Elliott County and located on Oliver Branch of Newcombe Creek, Kentucky & Ohio Gas Co. 1 William Oliver is showing for a well. Operators topped the Big lime at 560 ft., Injun sand at 670 ft., and Weir (Mississippian) sand from 976-1,076 ft. with good show of oil. With total depth at 1,080 ft., the well is being shot prior to taking production tests.

In southern Magoffin County and close to Breathitt County line, Bed Rock Petroleum Co. is drilling at 1,550 ft. after topping the Weir sand at 1,450 ft. with a show of oil. Previously the salt sand at 670 ft. showed oil saturation which may be tested if lower beds prove unproductive. This is a rank wildcat test some miles south of production in Royalton gas pool.

In Big Sinking pool of Lee County, Ashland Oil & Refining Co. has recently completed 47 Flahaven Land & Lumber Co. for 2 bbl. daily from Corniferous lime at total depth of 925 ft.

West Texas Field Trip

The fall field trip of West Texas Geological Society will be through the Malone, Quitman, and Franklin mountains in the westernmost part of Texas, along the Mexican border, October 7-8.

October 7 will be spent in the Malone Mountain overthrust area, and in the Quitman Gap area.

On October 8 the group will observe the overthrusting in the Juarez Mountains as well as the pre-Permian section in the Franklin Mountains.

Geologists will assemble at Van Horn and Sierra Blanca on October 6, with registration being held at Western Lodge in Van Horn and El Patio Court at Sierra Blanca.

Mid-Continent S.A.E.

NORMAN, Okla.—A paper dealing with the study of the problem of motor knock will be presented by D. L. Pastell, director of the combustion-research group of E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., at the meeting of the Mid-Continent Section, Society of Automotive Engineers here October 6. The paper is titled: "Precombustion Reactions in a Motored Engine." The group will meet at the Engineering Auditorium on the University of Oklahoma campus at 8 p.m.

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U. S. DEPARTMENT OF THE INTERIOR. Bureau of Land Management, Washington 25, D. C. Notice is hereby given that 4 units of land containing in all 440 acres in T. 16 S., R. 31 E., N.M.P.M., New Mexico, within the known geologic structure of the Robinson field, New Mexico, will be offered for oil and gas leasing through competitive bidding at 1 p. m., Eastern Standard Time, on October 11, 1950, when bids will be opened. Details of the lease offering, how and where to file bids and a description of the lands may be obtained by addressing an inquiry to the Manager of the Land and Survey Office, at Santa Fe, New Mexico, or to this office. Marion Clawson, Director.

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August 25, 1950

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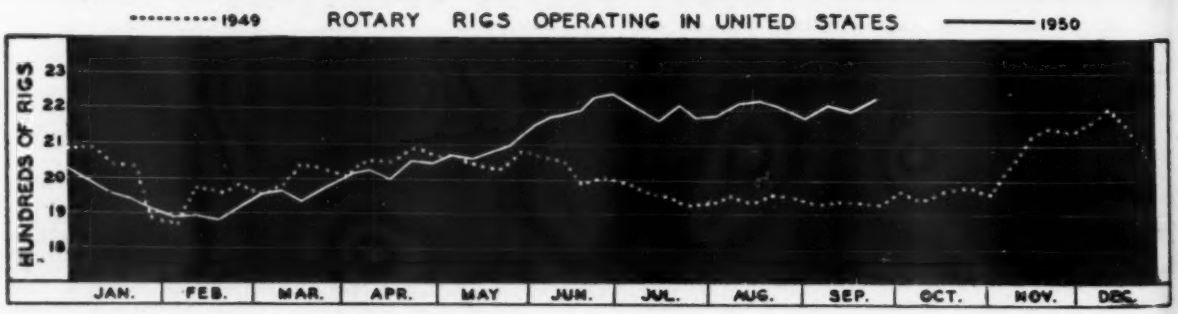
CURRENT STATISTICS

EXPLORATION

WEEKLY WELL COMPLETIONS . . WEEK ENDED SEPTEMBER 30, 1950

	Total of all wells					Sept. 30		Wildcat completions and discoveries									
													Cumulative total, 1950				
	Comp.	Oil	Gas	Dry	Footage	1950	1949	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
New York	15	8	0	*7	21,440	514	770	0	0	0	0	0	0	0	0	0	0
Pennsylvania	32	15	3	†14	53,367	1,000	1,231	0	0	0	0	0	0	0	1	2	3
West Virginia	13	2	9	2	31,200	496	376	0	0	1	0	1	0	0	18	16	34
Ohio	33	16	3	‡14	64,393	759	818	0	0	0	1	1	2	0	2	10	14
Indiana	33	7	1	25	52,972	1,239	995	0	0	0	5	5	42	0	1	198	241
Kentucky	30	14	0	16	55,148	860	712	2	0	0	6	8	22	0	1	74	97
Illinois	57	28	0	29	128,422	2,055	1,913	1	0	0	10	11	42	0	2	450	494
Michigan	18	1	6	11	47,181	655	760	0	0	0	9	9	24	0	4	222	250
Kansas	79	37	11	31	254,601	2,849	2,429	3	0	0	15	18	79	0	11	472	562
Nebraska	7	2	0	5	24,426	95	21	0	0	0	3	3	6	0	1	44	51
Oklahoma	116	76	2	38	404,645	4,046	3,221	3	0	0	10	13	124	6	15	496	641
Texas	301	210	8	83	1,336,626	12,235	10,114	9	2	2	47	60	377	34	86	1,940	2,437
North Central (Dist. 7-B & 9)	85	44	1	40	206,676	3,695	3,357	5	0	1	21	27	166	2	23	762	953
West (Dist. 7-C & 8)	110	91	0	19	602,417	3,688	2,434	1	0	0	15	16	73	2	4	375	454
Panhandle (Dist. 10)	13	10	1	2	39,239	689	726	0	0	0	0	0	1	0	2	14	17
Eastern (Dist. 5, 6, & 6-P)	16	14	1	1	73,712	863	633	0	1	0	1	2	13	5	3	146	167
Gulf Coast (Dist. 2 & 3)	32	20	1	11	202,423	1,718	1,499	1	0	1	6	8	64	14	31	283	392
Southwest (Dist. 1 & 4)	45	31	4	10	212,159	1,582	1,465	2	1	0	4	7	60	11	23	360	454
Louisiana	55	30	3	22	346,047	1,834	1,764	1	0	0	10	11	37	15	5	158	215
Northern	28	17	2	9	104,233	985	1,048	1	0	0	4	5	7	3	2	71	83
Southern	27	13	1	13	241,814	849	716	0	0	0	6	6	30	12	3	87	132
Arkansas	7	6	0	1	19,123	309	245	1	0	0	0	1	10	0	0	71	81
Mississippi	5	0	0	5	37,435	239	262	0	0	0	4	4	8	2	0	86	96
Southeastern States	0	0	0	0	0	46	37	0	0	0	0	0	1	0	1	26	28
Montana	2	1	0	1	7,944	187	196	0	0	0	1	1	1	0	0	31	32
Wyoming	10	8	1	1	48,106	427	443	0	0	0	0	0	18	0	0	54	72
Colorado-Utah	5	0	1	4	17,018	68	108	0	0	1	4	5	4	0	2	45	51
New Mexico	18	12	1	5	89,243	466	385	0	0	0	1	1	10	1	2	41	54
California	32	18	4	10	131,918	1,334	1,959	0	0	0	8	8	20	0	3	285	308
Miscellaneous	4	0	0	4	9,714	40	16	0	0	0	4	4	0	0	0	15	15
Total United States	872	491	53	328	3,180,969	31,753	28,775	20	2	4	138	164	827	58	155	4,736	5,776
Total previous week	934	506	70	358	3,205,966	....	....	27	3	7	131	168	807	56	151	4,598	5,612
Total September 30, 1949	750	426	57	267	2,625,927	....	....	13	1	4	111	129	713	67	152	4,190	5,122

Service wells included: *7, †13, ‡2.



DAILY AVERAGE PRODUCTION FOR WEEK

	Sept. 30 crude oil	B. of M. Sept. demand	Sept. 23 crude oil
Alabama	2,150	1,600	2,200
Arkansas	81,400	90,000	81,200
California	923,400	928,000	912,200
Colorado	66,550	67,000	67,100
Eastern	65,500	65,000	67,000
Florida	1,475	1,400	1,600
Illinois	173,900	188,000	173,200
Indiana	30,100	31,000	30,900
Kansas	313,850	306,000	313,800
Kentucky	28,100	30,000	27,900
Louisiana	577,800	590,000	577,750
North Louisiana	115,250	.....	115,200
South Louisiana	462,550	.....	462,550
Michigan	46,700	47,000	44,800
Mississippi	108,600	120,000	107,250
Montana	22,950	24,000	23,000
Nebraska	3,350	3,000	3,300
New Mexico	136,675	154,000	136,625
Oklahoma	469,500	460,000	461,300
Texas	2,620,800	2,260,000	2,620,800
Dist. 1 (Southwest)	30,800	.....	30,800
Dist. 2 (Southwest)	150,950	.....	150,950
Dist. 4 (Southwest)	235,250	.....	235,250
Dist. 3 (Gulf Coast)	454,625	.....	454,625
Dist. 5 (Eastern)	44,075	.....	44,075
Dist. 6 (Eastern)	104,250	.....	104,250
East Texas field	305,400	.....	305,400
Dist. 7-C (West)	66,450	.....	66,450
Dist. 8 (West)	905,950	.....	905,950
Dist. 7-B (W. Central)	75,150	.....	75,150
Dist. 9 (N. Central)	156,500	.....	156,500
Dist. 10 (Panhandle)	91,400	.....	91,400
Utah	3,800	4,000	3,600
Wyoming	164,000	170,000	164,300
Total United States	*5,840,600	5,540,000	5,819,825
Change from previous week, up	20,775		
Canada	86,985	.....	92,700

Total U. S. production January 1-September 30 †1,442,233,695 bbl.
Same period last year (crude plus cond.) ..... 1,382,392,085 bbl.

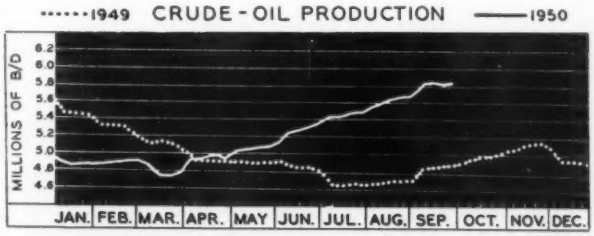
*Not including 97,490 bbl. condensate. †Including 26,553,345 bbl. condensate.

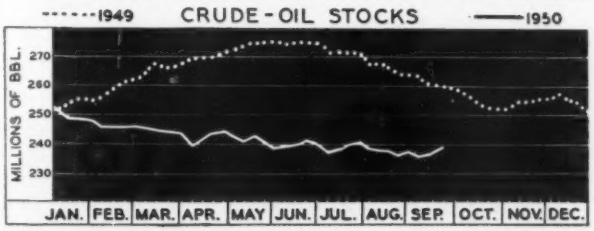
CRUDE-OIL STOCKS BY STATES OF ORIGIN*

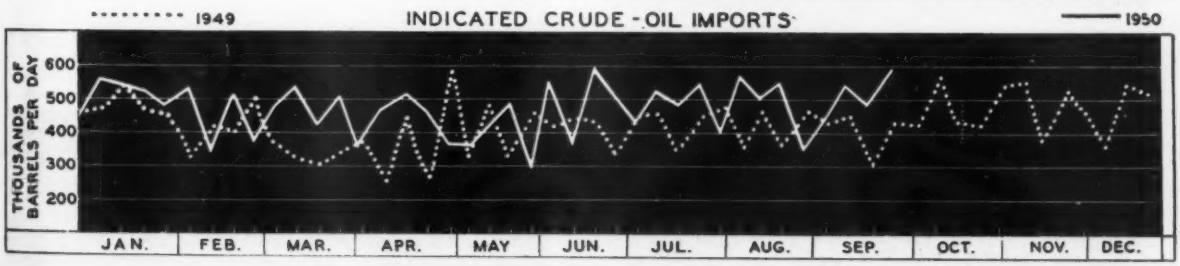
(Thousands of barrels)

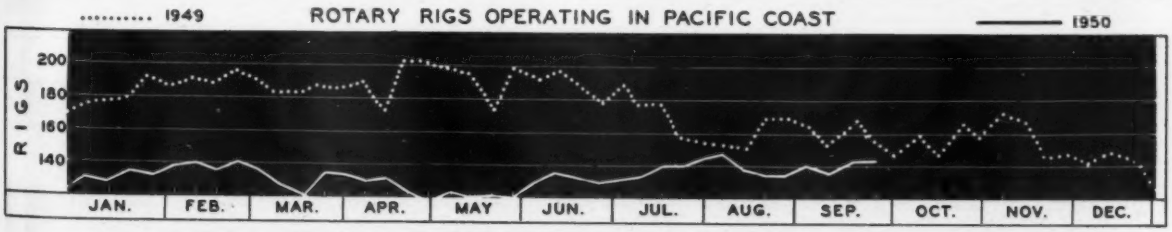
	Sept. 23, 1950	Sept. 16, 1950	Sept. 24, 1949
Pennsylvania Grade	2,395	2,463	3,210
Other Appalachian	1,313	1,423	2,114
Illinois, Indiana, Michigan	9,611	9,783	12,595
Arkansas	2,916	2,909	2,849
Louisiana	14,225	14,302	14,473
North	3,218	3,153	3,579
Gulf	11,007	11,149	10,894
Mississippi	2,617	2,470	2,680
New Mexico	6,408	6,258	7,328
Oklahoma and Kansas	35,257	34,362	38,416
Texas	117,399	115,697	118,835
East Texas	13,678	13,689	17,444
West Texas	46,150	45,448	46,738
Texas Gulf	28,454	28,430	29,329
Other Texas	29,117	28,130	25,324
Rocky Mountain	10,432	10,459	13,896
California	30,719	30,987	35,832
Foreign	6,349	6,042	6,961
Total	239,641	237,155	259,189

*Bureau of Mines.







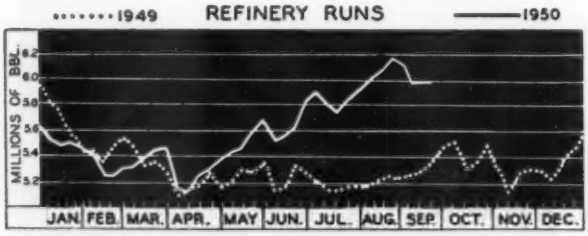


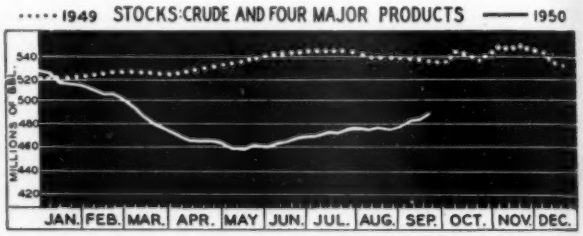
A.P.I. REFINERY REPORT, SEPTEMBER 23

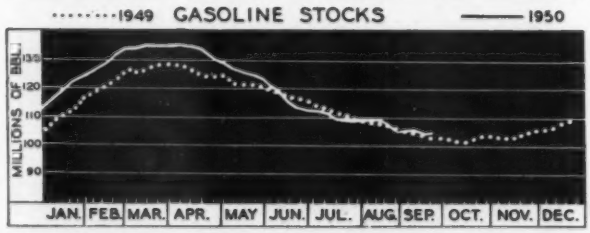
(Thousands of barrels)

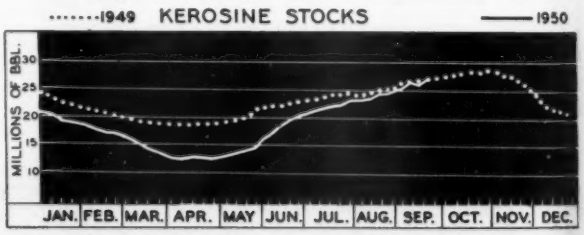
District—	Daily avg. crude runs	Daily average production				Stocks at refineries, bulk terminals, in transit and in pipe lines				Bureau of Mines, September 1949				
		Gasoline*	Kerosine	Distillate	Residual	Gasoline†	Kerosine	Distillate	Residual	Daily avg. crude runs	Daily average production: Gasoline*	Kerosine	Distillate	Residual
East Coast	988	402.7	42.0	174.9	237.8	25,490	10,193	22,308	11,421	777	319.8	25.4	172.3	176.9
Appalachian:														
District 1	109	48.9	7.7	13.0	10.7	2,377	482	694	433	98	46.9	5.0	13.2	10.0
District 2	76	39.1	5.6	11.4	13.6	1,194	150	202	192	67	35.1	4.1	7.2	13.6
Ind., Ill., Ky.	937	505.3	61.1	164.4	136.9	20,736	5,881	12,644	4,525	925	504.7	57.6	126.8	142.0
Okla., Kans., Mo.	512	284.6	15.6	118.6	62.4	10,129	1,472	7,766	1,328	418	241.6	14.4	82.1	60.9
Inland Texas	181	119.7	11.6	28.3	32.0	3,280	518	1,246	687	214	140.5	10.4	27.9	42.4
Texas Gulf Coast	1,498	669.0	112.1	302.6	256.8	15,728	4,460	11,341	5,952	1,325	606.1	81.4	282.0	233.8
La. Gulf Coast	484	226.1	60.6	105.3	56.9	6,572	2,659	3,852	2,320	456	220.8	47.2	106.3	60.8
N. La. and Ark.	80	28.6	7.8	18.1	10.9	2,030	578	751	292	73	30.9	6.3	10.6	15.0
Rocky Mountain:														
New Mexico	13	6.3	.4	2.7	3.7	79	25	25	33	10	5.8	.2	1.7	2.6
Other Rocky Mtn.	184	79.6	3.9	32.7	30.6	3,121	482	2,052	808	194	89.9	5.7	34.9	33.6
California	920	408.1	8.0	144.6	341.4	14,003	732	12,198	14,328	870	375.1	12.1	136.6	318.4
September 23, 1950	5,982	2,818.0	336.4	1,116.6	1,193.7	104,739	27,632	75,079	42,319	5,427	2,617.2	269.8	1,001.6	1,110.0
September 16, 1950	5,983	2,804.0	310.7	1,187.7	1,165.7	104,305	26,577	74,136	42,208	.....	.....	.....	.....	.....
September 24, 1949	5,379	2,593.1	272.9	936.4	1,059.9	103,262	26,615	81,414	68,143	.....	.....	.....	.....	.....

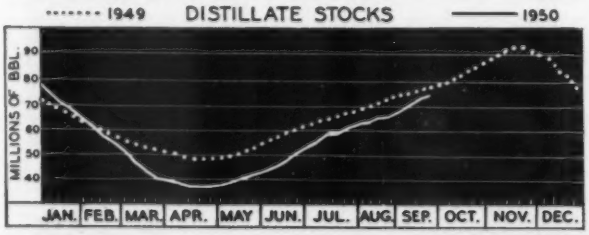
*At refineries including natural blended. †Finished and unfinished.

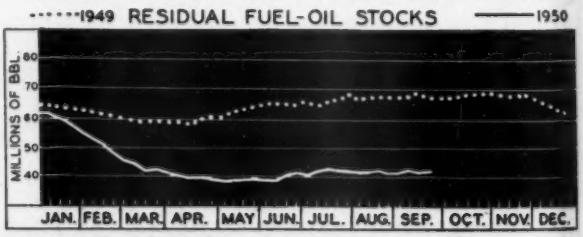


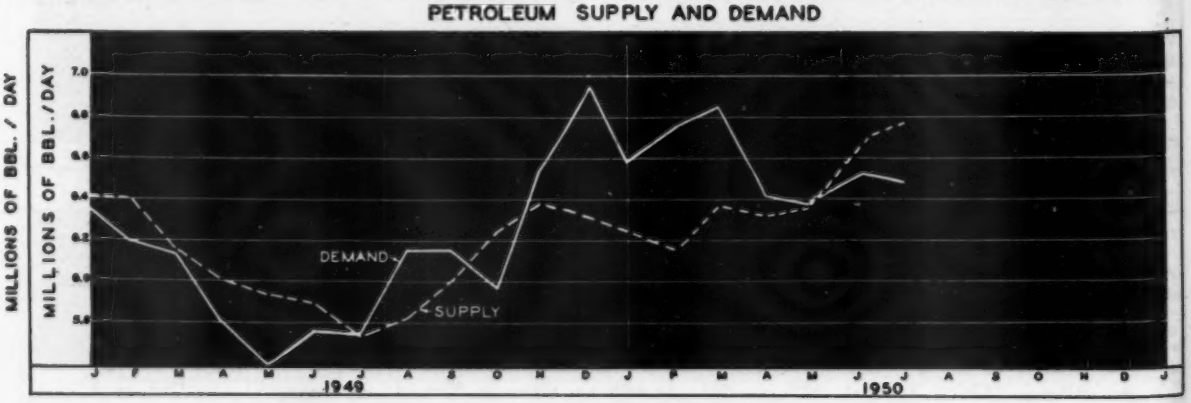











PETROLEUM SUPPLY AND DEMAND
MILLIONS OF BBL. / DAY
MILLIONS OF BBL./DAY
DEMAND
SUPPLY
J F M A M J J A S O N D J F M A M J J A S O N D J
1949
1950

CRUDE PRICES

GRAVITY SCHEDULE

Gravity—	Signal Hill, Calif.	Okla-homa, Kansas	Gulf Coast Tex.*	West Tex.†
18-18.9	$1.69	....	....	....
19-19.9	1.77	....	....	....
20-20.9	1.85	$2.25	....	$2.12
21-21.9	1.93	2.27	....	2.14
22-22.9	2.00	2.29	....	2.16
23-23.9	2.08	2.31	....	2.18
24-24.9	2.15	2.33	$2.56	2.20
25-25.9	2.23	2.35	2.58	2.22
26-26.9	2.31	2.37	2.60	2.24
27-27.9	2.37	2.39	2.62	2.26
28-28.9	2.42	2.41	2.64	2.28
29-29.9	2.48	2.43	2.66	2.30
30-30.9	2.54	2.45	2.68	2.32
31-31.9	2.59	2.47	2.70	2.34
32-32.9	2.64	2.49	2.72	2.36
33-33.9	....	2.51	2.74	2.38
34-34.9	....	2.53	2.76	2.40
35-35.9	....	2.55	2.78	2.42
36-36.9	....	2.57	2.80	2.44
37-37.9	....	2.59	2.82	2.46
38-38.9	....	2.61	2.84	2.48
39-39.9	....	2.63	2.86	2.50
40 and above	....	2.65	2.88	2.52

*For crude from Daboval, El Campo, and Sand Point.

†Includes Lea County, New Mexico. Last general price change represented a 50-cent increase becoming effective December 6, 1947.

FLAT CRUDE PRICES

Representative posted schedules per barrel.

East Texas†	$2.65
Kettleman Hills, California*	2.77
Beauregard Parish	2.60
Illinois Basin	2.77
Pecos County, Texas (Yates)	2.35
Bradford, Pennsylvania	4.00
Eastern Ill. and Western Ind.†	2.77
Tomball, Texas Gulf Coast	2.83

*37°-37.9°. †35° and above.

DEMAND for natural gasoline in the Mid-Continent area continues strong with another price increase of .125 cent reported last week. The new price for Grade 26-70 on the Group 3 market is 6.375 cents a gallon, still 2.125 cents below the 1948 level. In contrast, the price of regular gasoline on the Group 3 market is only about .125 cent below quotations in 1948.

The major factor in spot markets of the Gulf-East Coast areas has been the activity-cutting influence of the sharp upward trend in tanker rates. By the middle of last week rates had gone as high as 40 per cent over the old Maritime Commission base for clean vessels and 35 per cent over for dirty ships. These rates represent transportation costs of 1.27 cents a gallon for No. 2 fuel and 59.2 cents a barrel for No. 6.

Since the heavy movement of distillates out of primary storage during the summer months indicates that much of the consumer and reseller storage has been filled, important additions to primary stocks can be expected between now and the time that consumers and resellers make purchases for refills. Many East Coast suppliers are reluctant to make offerings of home-heating fuel since the changing tanker market makes it very difficult to calculate replacement costs. Some market observers are discussing the possibility of a price increase sometime in the first half of this month since the price-protection period extended only to the end of September.

Standard Oil Co. of California has announced price increases in its gasolines and other products effective October 3. The general increase was 0.2 cent a gallon with 0.3 cent posted for Seattle and Portland and 0.4 cent for San Francisco, Bakersfield, and Los Angeles. Heavy fuel prices were not raised.

REPRESENTATIVE QUOTATIONS

Representative spot-market quotation of leading suppliers as of October 2, 1950. Figures are f.o.b. plant for tank-car shipments in cents per gallon, except for residual fuel oil which shows the price per barrel and wax, in cents per pound.

GASOLINE, KEROSINE, AND FUEL OILS

	Mid-Continent Group 3	New York Harbor (barge)	Texas Gulf Coast
Regular gasoline, 80-82 octane	10⅜-10½	12.5-12.75	10¾-11⅛
Premium gasoline, 86-88 octane	11¼-11½	13.5-13.75	11½-12
42-44 w.w. kerosine	8⅞-9	9.5	8½-8¾
No. 2 straw fuel oil	8⅛-8¼	8.5	7½-7¾
No. 6 residual	$1.65-1.75	$2.15-2.25	$1.80-1.85

NATURAL GASOLINE

	Group 3	North Texas	N. La.
Grade 26-70	6⅜	5⅞	6⅛
Grade 18-55	7.65	7.15	7.4

LUBRICATING OILS

South Texas

200 vis., No. 2-3 neutral	12.5
750 vis., No. 3-4 neutral	14.75
2,000 No. 5-6 neutral	16.5

LUBRICATING OILS

Mid-Continent

150-160 vis., D bright stock, 0-10 pp.	26-27
200 vis., No. 3 neutral, 0-10 pp.	15.5-17.5

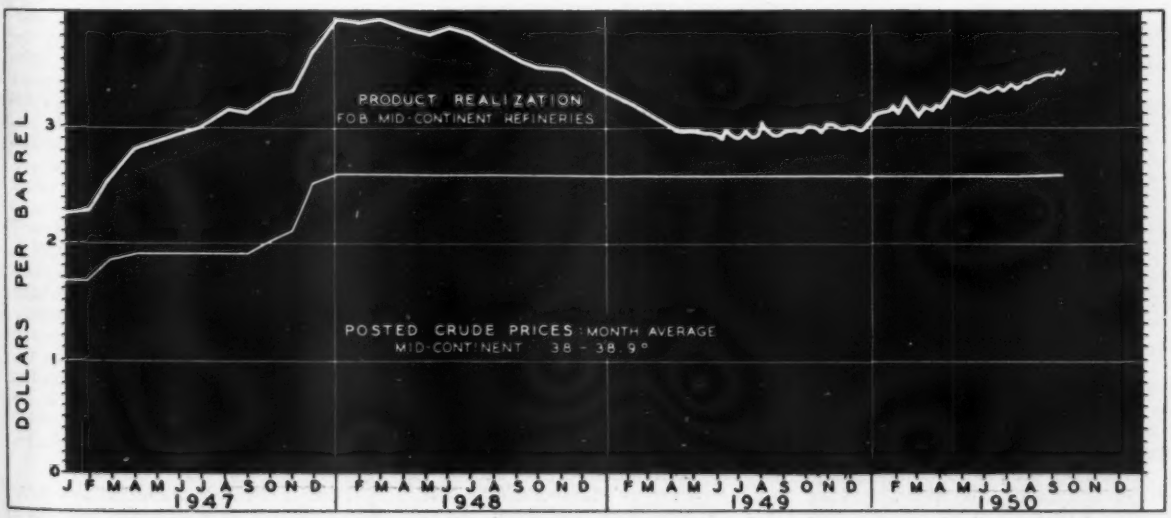
Western Pennsylvania

145-155 vis., 10 p.t. bright stock	28
180 vis., 0 p.t. neutral	29

WAX

Mid-Continent

132-134 A.M.P.	5.0


PRODUCT REALIZATION
F.O.B. MID-CONTINENT REFINERIES
POSTED CRUDE PRICES: MONTH AVERAGE
MID-CONTINENT 38 - 38.9°
DOLLARS PER BARREL
0
1
2
3
J F M A M J J A S O N D
1947
F M A M J J A S O N D
1948
F M A M J J A S O N D
1949
F M A M J J A S O N D
1950

In this trend chart refinery realization is based on average Mid-Continent grade crude oil (not 38° gravity only) and average prices for refinery products as published in The Oil and Gas Journal basis Oklahoma (Group 3). Refinery yields confined to gasoline, kerosine, distillate, and fuel oil. Realization averaged $3.51 for week ended September 23, $3.47 for previous week, and $2.99 for September 1949.

EQUIPMENT MEN ... in the News

Tuboscope Announces Two Executive Appointments

J. W. Bozeman, general manager of Tuboscope Co., has announced the

HARRY BOZEMAN

B. H. PICKARD

election of Harry Bozeman, formerly sales manager of the company, to the position of vice president in charge of operations in Louisiana and Mississippi. New Iberia, La., serves as headquarters for this division of the company, and Bozeman will make his residence in that city. He will be in charge of all branches of the company's work, the inspection of drill pipe, tubing, and casing, tubing caliper surveys, and other wire-line services.

At the same time J. W. Bozeman announced the election of B. H. Pickard as vice president in charge of operations for the Texas Gulf Coast. Pickard's headquarters will be in the newly constructed divisional office located in Houston, from which point he will direct field activities for the company in that area.

Emsco Announces Executive Personnel Changes

PAUL COURTNEY

Paul Courtney, recently appointed vice president of Emsco Derrick & Equipment Co., and former manager of the Houston plant, has been appointed vice president and general manager of sales for all Emsco products, excluding D+B sales. Courtney, who has been with Emsco since 1938, is headquartered at Houston. At the same time, it was announced that S. A. Martin, former assistant plant manager, succeeds Courtney as manager of the Houston plant. Martin has been with Emsco since 1927. F. M. Martin, manager of jobber sales, has assumed duties as assistant plant manager of the Houston plant. He joined Emsco in 1932.

J. T. Tucker continues as sales manager of Emsco, covering the Mid-Continent, Rocky Mountain, Canadian, and Eastern areas. Tucker joined the Emsco organization in 1940 as a field serviceman.

Johnston Pump Names New Vice Presidents

Thomas W. Simmons, president of Johnston Pump Co., Los Angeles, has announced that, at the last board of directors meeting, Kenneth G. Lundie was elected vice president in charge of sales, and P. H. Brown was elected vice president in charge of engineering.

K. G. LUNDIE

P. H. BROWN

Brown has been chief engineer at Johnston, and Lundie has been sales manager. Both men have been in the vertical-turbine pump industry for many years, with Johnston Pump Co. and other manufacturers.

Edmund P. Lunken Named Lunkenheimer Secretary

E. P. LUNKEN

Edmund P. Lunken, vice president of Lunkenheimer Co., has been elected secretary, succeeding Charles W. Burrage, now manager of sales engineering, who resigned to devote full time to sales.

A graduate of Yale University, Lunken has been associated with Lunkenheimer since 1936. Charles W. Burrage, a graduate of Harvard University, has been with Lunkenheimer since 1924. Prior to joining Lunkenheimer he served as an instructor at Massachusetts Institute of Technology, worked in the engineering department of Manning, Maxwell & Moore, Inc., and was chief engineer of Nelson Valve Co.

White Made Manager Of Jarecki Manufacturing

C. L. WHITE

Charles L. White has been appointed general manager of Jarecki Manufacturing Co. division of H. K. Porter Co., Inc., with headquarters in Houston, it has been announced by T. M. Evans, president.

White's experience covers more than 25 years of sales, store management, and sales engineering with Continental Supply, Bridgeport Machine Co., Williamsport Wire Rope Co., and its successor, Bethlehem Steel Co. In his new position he will be responsible for the over-all operation of all the Jarecki oil-field-supply stores throughout the country.

Butler Buys Fabricating Plant at Birmingham

Butler Manufacturing Co., Kansas City, Mo., fabricator of steel buildings, welded and bolted tanks, and numerous other metal products, has purchased a practically new steel fabricating plant at Birmingham in order to increase its output. The property was purchased from W. L. Coston & Sons.

The Kansas City company purchased the factory building, the equipment, and the 40-acre site upon which the building stands. The main factory building is a one-story, gable-type building, 148 by 250 ft. With annexed buildings there are approximately 46,000 sq. ft. of floor space. The building is of structural steel with galvanized sheet steel roof and siding, and a 60-ft. wide craneway through the building extends 150 ft. beyond one end and 210 ft. beyond the other end, making a total length of 610 ft. of 60-ft.-wide craneway. This and two 40-ft.-wide craneways each 250 ft. long, are utilized in receiving, manufacturing, and shipping operations. Butler's new plant is located conveniently near large steel mills and is served by two switches of the Frisco Railroad.

Oscar D. Nelson, president and general manager of Butler Co., said that for many years Butler has been interested in establishing manufacturing facilities in the Southeast.

Your MARKET PLACE FOR THE OIL AND GAS INDUSTRY...

CLASSIFIED ADVERTISING

UNDISPLAYED CLASSIFIED 12c a word one issue. 10% Discount three or more issues. $3.00 minimum charge. Blind Box in our care counts nine words. Payable in Advance.

DISPLAY CLASSIFIED
$12.00 a column inch one issue . . .
10% Discount three or more issues.

EQUIPMENT FOR SALE

FOR CABLE TOOLS
DEGEN PIPE AND SUPPLY CO.
Box 107, Red Fork Station, Tulsa, Oklahoma

USED ROTARY AND CABLE TOOL DRILLING TOOLS, WIRE LINES. E. A. KELLY, BOX 861, OKLAHOMA CITY. PHONE 5-6407.

WELL equipment. New and used spudders, rotaries, core drills, all sizes and types. Cable tools, drill pipe, bits, pipe. Fishing tools rented. Everything for well service. Pressey & Son, Pueblo, Colo.

FOR SALE: 300 Amp Westinghouse welding machine powered by 6-BK Waukesha engine. Completely overhauled. Less than 50% of new price. Melton Supply Company, Box 1360, Seminole, Oklahoma.

BARGAIN FOR QUICK SALE

Large Steam Rig Complete Ready to go. 14x14 Engine, 18" & 20" Pumps, 10,000' 4½ Drill Pipe, 136' Drk All 300 Ton Equipment. Everything Good Condition. **McDaniel & Beecherl Drlg. Co.,** Phone: Randolph 6910, Dallas, Texas, or Phone 3651, Odessa, Texas.

FOR SALE

1000 ft. of 3" upset tubing. Like new. 80c per ft.

4000 ft. 2⅜" range 1 drill stem. Hughes Acme tool joints. Like new. $1.50 per ft.

1550 gal. Army Air Force tank and trailer—new. $750.

Four 700 gal. glass insulated skid-mounted tanks. $300. Perfect for winter work in Wyoming and Kansas.

CLEMENS EXPLORATION
Box 136, Princeton, Ind.

Available for Immediate Delivery

C. F. R. — A. S. T. M.

OCTANE ENGINE

complete with all accessories.

Price $4,250

May be inspected at
408 No. Boston Ave., Tulsa, Okla.

Write, wire or phone

Sidney Born

2-2186, Tulsa, Oklahoma.

EQUIPMENT FOR SALE

6,218 FEET 7" O.D. 17# new seamless casing H-40 Rg 2 @ 2.90 ft. Phone 5-8850, Tulsa.

RECONDITIONED money-saving Franks SA-4500 Rotary Drilling Rig equipped with 96-foot derrick and rotary table. Write: Box D-681, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE

7500' 2" xx seamless pipe approx. 400' new 16" bell & spigot 150# cast iron pipe—at mill price.

BOX 574, Tulsa, Oklahoma.

EQUIPMENT FOR SALE

HYDRAULIC CASING PULLING Machine: 7' jacks, 3-ram skid-type unit. N. R. Bennett, 111 South Division, Sapulpa, Oklahoma. Phone 1828 (after 4 p.m.).

FAILING 3000' capacity truck mounted rig, Buda powered, 55' mast rack 40' pipe, priced to sell. Box D-692, The Oil and Gas Journal, Tulsa, Oklahoma.

Several Army Surplus 4½" x 6" Gaso Duplex 1860 Pumps — two piece skid mounted with Chrysler 8 cylinder engines. Will sell pumps only or complete units about half price.

H. H. COFFIELD
ATTN: W. H. Orr
Phones: 132—Rockdale, Texas
A-86064—Houston, Texas

PIPE FOR SALE

NOW AVAILABLE—150 Miles 8⅝" OD Strictly #1 Grade Used 28.55# Welded Steel Line Pipe Double Random Lengths Beveled Ends. Located Dallas-Corsicana area.

Standard Pipe Supply Company

P.O. Box 243, Houston 1, Texas

LIQUIDATION SPECIAL!

COMPLETE WATER TREATING UNIT

Hot Lime System

3200 G.P.H. Make-Up 18000 G.P.H. Condensate

Manufactured by Permutit.

Consists of:

Chemical feed tank 5' x 3' 8" w/motor driven agitator.
Chemical pump.
Hot lime soda filter 5'6" x 7'4", 4300 G.P.H. capacity.
Wash pump for above.
Hot lime soda deaerator and softener 9' x 26' on 9' stand.
All controls, valves, fittings, etc., necessary for operation.

FIRST CLASS CONDITION IN EVERY RESPECT

WRITE — WIRE — PHONE

FOR COMPLETE

INFORMATION AND

OTHER LISTINGS

DULIEN STEEL PRODUCTS, INC
of Washington
P. O. BOX 667
COTTON VALLEY, LA.
PHONE: COTTON VALLEY 26

XUM

EQUIPMENT FOR SALE

TO SETTLE ESTATE: Two hydraulic casing pulling machines, mounted on skids, complete with small tools, also extra equipment for large size casing. One unit with friction clutch winch. Sell as one lot only. Reasonably priced. Located Tulsa. Box D-686, The Oil and Gas Journal, Tulsa, Oklahoma.

EQUIPMENT FOR SALE

WAR SURPLUS MACHINERY

Gaso, Byron Jackson, Aurora, Wayne, Lombard & Hale Fire Pumps with Engines, 1½ to 25 KW Generator Sets or Light Plants, Engines, Suction Hose, Fire Hose, Victaulic Couplings & Etc. Write for listing. H. A. McCarthy, 310 Thompson Bldg., Phone 5-3296, Tulsa, Oklahoma.

EQUIPMENT FOR SALE

FOR SALE: 1942 Model Fort Worth Jumbo "C" Spudder in good repair and complete with tools. Skid type Advance Rumley pipe pulling unit capable of 4000′ well servicing also in good condition. Large supply of cable tools also for sale. G. W. Hicks, Moline, Kansas.

FOR SALE

75,000′ 2⅜″ O.D. 3.75# & 4# Good Used Lapweld Line Pipe, 11½ V-Thread.

125,000′ 3″ Standard 7.57# Good Used Lapweld Line Pipe, Machine Cleaned, Torch Beveled Ends 30°. Available for inspection first week of October and shipment within two weeks, FOB Illinois.

125,000′ 4″ OD x .165″ Wall Seamless, 6.5#, Used as sweet gas line and will be taken up in 30′ Lengths within the coming week, available for inspection thereafter, FOB Borger, Texas.

25,000′ 5″ OD x .125″ Wall New Electric Weld, 6.5# P/FT, PESC, 40′ Lengths, 800# Test, FOB Salt Lake City, Utah.

25,000′ 5″ O.D. x .438/.563″ Wall New Seamless, 20′-32′ Lengths.

CASING & TUBING

7,000′ 2⅞″ O.D. 6.4# New Seamless, Range 2, 10 Round Thread Regular Tubing.

10,000′ 8⅝″ O.D. 25# Used Lapweld Casing, New Threads and New Collars.

3,000′ 10¾″ O.D. Used Lapweld Casing, New Threads and New Collars.

FOR FURTHER INFORMATION, WIRE OR PHONE AT ONCE

A. J. STRUBEL

SIDney 1791 ... 4946 Murdoch, St. Louis, Mo.

FOR SALE

9—230 H.P. Bessemer Type 10 Engines with compressors, Steel Buildings, Valves and Fittings complete for installation. Located Salem, Illinois Oilfield.

ENGLE PETROLEUM, INCORPORATED
Box 655, Evansville, Indiana
Telephone 5-5179

WOOD TANKS

OAK AND CYPRESS BREWERY TANKS

4—Size 10′ x 17′, closed 2¼″ staves, manholes, etc. ..... $500.00 ea.

All clean, knocked down, F.O.B.

C. R. Sherrill

Route #1

Burrton, Kansas **Telephone 2-1006**

FOR SALE
USED DRILLING EQUIPMENT

POWER EQUIPMENT

1—Wilson Titan drawworks unit and compounding transmission on subbase driven by 2—LRO Waukesha gas engines butane equipped, including 40″ Parkersburg hydro brake package, plain cathead driller's side, American simplomatic breakout cathead opposite driller's side. Location: Elk City, Okla. Price ..... **On application**

1—Wilson Giant rig powered by 2—L-600 Cummins diesel engines, fitted with plain cathead driller's side, American simplomatic breakout opposite side. Location: near Seminole, Okla. Price ..... **On application**

STEAM EQUIPMENT

At Baxterville, Miss.

3—150 H.P. 350# W.P. Kewanee Boilers, Lot **$12,000.00**

2—15″ x 7¾″ x 20″ Series 20 Oil Well Steam Slush Pumps, Lot **$3,000.00**

1—Boiler feed unit complete including 2—Ideal 10″ stroke steam pumps, 2—5KW Turbolite generators and firing control mounted on 8″ steel skid **$1,000.00**

At Houston, Texas

1—14 x 14 Ideal, Series A, National Drilling Engine with lubricator and cut-off valve **$6,500.00**

1—Union Tool, Series 239-F, Drawworks with 40″ single hydromatic and multiple-jaw cut-out couplings, unitized oil bath, by Hunt Tool Company, complete with Foster Spinning Cathead and American Breakout Cathead, Grizzly Turnback; has made three 9,500′ wells since being reworked **$8,750.00**

1—15½, 7¾ x 20, Gardner-Denver pump with lubricator **$2,500.00**

1—125 HP, 300# WP Kewanee boiler, with dome over barrel 72″ Fire box, all standard fittings including Volcano burners **$2,000.00**

2—125 HP, 300# WP, Farrar & Trefts welded barrel boilers with domes over barrel, 84″ fire box, including all fittings and Volcano burner and boiler jacks. $2,750.00 each ..... Both **$5,500.00**

1—100-TA Bethlehem Swivel Complete (overhauled), **Alice, Texas** **$1,100.00**

1—EH-7 Sheave Reagan Crown Block, **New Iberia, La.** **$1,250.00**

1—66″ 4-Sheave Emsco Traveling Block, **Lindsay, Okla.** **$350.00**

1—Used Oilwell #200 Crown Block w/ 6—36″ sheaves grooved for 1⅛″ wire line, **Elk City, Okla.** **$500.00**

Used on but one well since being completely overhauled and having new races and bearings installed.

Box D-702, The Oil and Gas Journal, Tulsa, Oklahoma

BUTANE AND HOT OIL PUMPS

1—Slightly Used Dean Bros. 8″x 7″x18″ Simplex Close Clearance Pump, For Liquid Petroleum, 90 GPM—400 PSIG, Ea. .. $750.00

1—Slightly Used Dean Bros. 12″x 7″x18″ Simplex Close Clearance Pump, For Liquid Petroleum, 90 GPM—400 PSIG, Ea. .. $750.00

1—Slightly Used Union 14″x8″x 12″ Simplex Hot Oil Pump, Special Forged Steel Fluid End, 750# 650° F. 100 GPM, Ea. $500.00

1—Slightly Used Snow 10″x4½″x 12″ Duplex Hot Oil Pump, Special Forged Steel Fluid End, 750# 650° F. 148 GPM, Ea. $500.00

2—Slightly Used Union 7½″x4½″ x10″ Duplex Hot Oil Pumps, Special Forged Steel Fluid End, 750# 650° F. 132 GPM, Ea. $500.00

ALL HOT OIL PUMPS TESTED 1200#

H. A. McCarthy

310 Thompson Bldg. **Phone 5-3296**
Tulsa 3, Okla.

DRILL PIPE

10,000 ft. 3½″ OD used seamless, weighing approx. 13# per foot, with tool joints.

USED SEAMLESS STEEL TUBING
Plain End Beveled for Welding

75,000 ft. 2¼″ OD, approx. 2.90# per ft.
25,000 ft. 3½″ OD, approx. 5# per ft.
25,000 ft. 4″ OD, approx. 6# per ft.
25,000 ft. 5½″ OD, approx. 9# per ft.

All reconditioned, hydrostatically tested to 850# pressure.

• • • • • •

18,000 ft. 6″ OD used electric welded steel pipe, approx. ⅛″ wall, 24′ lengths.

• • • • • •

All material guaranteed in first-class condition. All ready for IMMEDIATE SHIPMENT.

• • • • • •

New and Guaranteed Used STEEL TANKS, Riveted, welded and bolted, in all capacities; also WOOD TANKS.

A. GREENSPON PIPE CO., INC.

3615 Olive St., St. Louis 8, Mo.
LUcas 5451

EQUIPMENT FOR SALE

AVAILABLE for sale and immediate shipment #1 T & C 2" line pipe, seamless and lapweld casing, tanks. Call or write Edco Pipe & Supply Company, Box 565, Drumright, Oklahoma.

FOR SALE near Madison, Kansas, 3—4 Bandwheel and Geared Pumping Powers Complete, Inventory on Request. Cities Service Oil Company, Patridge, Bartlesville, Oklahoma.

FOR SALE at Bartlesville, Oklahoma, one used Franks Manufacturing Company, Tulsa, Model 1000 Shothole Drill, 1000' Capacity, 10' Telescoping Hydraulic, 4" x 5" GD Mud Pump bought new 1943, Mounted on and Driven by 1942 Ford Truck, $2750. Cities Service Oil Co., Patridge, Bartlesville, Oklahoma.

FOR SALE: Erected near Russell, Kansas, 2—94' API Moore Angle Iron Drilling Derrics 333,000# Capacity with Crown Blocks each $500.00. Cities Service Oil Co., Patridge, Bartlesville, Okla.

BOILERS FOR SALE: 18 Code Oil Field Boilers, 50 to 87 H.P., 100 to 200 Lbs. W.P.; Operated Under Hartford into 1948, Not Fired Since. Located on Leases Vicinity Pampa, Texas. Offered Subject to Prior Sale. $500.00 to $700 each, as is, where is. Contact Max Harbison, Kewanee Oil Company, Pampa, Texas.

3 PHASE 60 CYCLE GENERATING UNITS
One—140 KW and One 60 KW—2300 Volt Fairbanks-Morse Diesel Type Complete with panel. One 125 KW 480 Volt 514 RPM Electric Machinery Engine Type Generator with exciter. One 35 KW 480 Volt 900 RPM Generator with exciter. Alfred B. Kern, 223 Wright Bldg., Tulsa, Oklahoma.

FOR SALE

2500'—16" O.D. 5/16" Wall Used P.E. Line Pipe. Excellent Condition

Buckeye Supply Company

P.O. Box 751, Zanesville, Ohio

200,000 LBS. OF FOAMITE

Mfg. by Pyrene Co. . .Excellent condition. Field lab tested. Sealed in original tin carton. Wgt. 47 lbs. per can.

MAKE US AN OFFER

Write—Wire—Phone

PHILIPS DISTRIBUTING CO.
29 East 7th South, Salt Lake City, Utah
Ph. 9-9632

FOR SALE

Approx. 30,000' 8" PE used line pipe, cut out in double random lengths. Located at Lovell, Wyoming.

Brown Pipe & Machinery Co.

P.O. Box 2368 **Phone 3-9391**
Corpus Christi, Texas

New Seamless Line Pipe

20,000' 16" O.D. x .250 Wall Spec. 5LX42.

225,000' 8⅝" O.D. x .277 Wall Spec. Grade B5L.

All seamless A.P.I. 30 to 44 ft. DRL, Plain Ends beveled. Write for complete delivery schedules and prices.

MID-STATES PIPE & SUPPLY CO.

Box 2534 **Ph. 2-9128**
Tulsa, Oklahoma

EQUIPMENT FOR SALE

BARGAIN for Quick Sale: 15 New, No. 16 Underpull Jacks, manufactured by American Mfg. Co., with Oil Bath Bearings and Oil Seal Rings with Bushings. Service Supply Company, Box 485, Greggton, Texas.

CORE-DRILL Equipment for Sale: Franks Model "2,000" rig, mounted on KR-11 International Truck, complete with 38' derrick, Gardner-Denver 5x8 power mud pump, 2,000 watt Kohler light plant, and standard operating accessories. Contact Mr. J. D. Baker or Mr. W. H. Hawkes, P.O. Box 1654, Oklahoma City, Oklahoma. Telephone No. 2-6381.

FOR SALE: 10,000' 6" O.D. P.E. 10 lb. line pipe, double random lengths. Beveled, ready to lay. This is No. 1 pipe. Price 80c. M. J. Regan, Coffeyville, Kans.

FOR SALE: Wichita 50-Hercules engine—tools—lines—pipe sufficient for 2500 ft. hole. F. E. Hunt, Adair, Iowa.

FOR SALE: Gasoline storage tank, horizontal 9' x 25' 3/16 gauge welded. Capacity 12,500 gallons. Good as new. Price $500.00. M. J. Regan, Coffeyville, Kans.

USED EXPANSION JOINTS FOR SALE

18"x24"—7½c per lb. FOB, Toledo, Ohio.
THE ELYRIA BELTING & MACHINERY CO.
Box 5, Elyria, Ohio.

NEW 24" O.D. PIPE

7,000 ft.—24" O.D. Pipe, ¼" wall, Republic Electric Fusion Weld, 30' lengths, Plain Ends beveled. Location: Harvey, La.

MID-STATES PIPE & SUPPLY CO.
Ph. 2-9128 **Tulsa, Okla.**

New API Seamless Casing
Immediate Delivery

20,000 ft. 7" 23# J 55
2,000 ft. 7" 29# N 80
1,000 ft. 11¾" 47# J 55

SUBJECT TO PRIOR SALE
PRICE ON APPLICATION

R. H. Tecklenborg Co.

811 W. 7th Street **Trinity 2091**
Los Angeles, California

Reconditioned
Seamless Tubing

65,000 ft. 1⅞" O.D.
55,000 ft. 1½" O.D.
40,000 ft. 2" O.D.
30,000 ft. 3¼" O.D.
20,000 ft. 3½" O.D.
25,000 ft. 4" O.D.
45,000 ft. 5½" OD.

Approximately 9 gauge wall.
Single or Double Random Lengths.

WRITE—WIRE—PHONE

SONKEN-GALAMBA CORPORATION
2nd and Riverview (X-630)
Kansas City 18, Kansas
THatcher 9243

EQUIPMENT FOR SALE

FOR SALE: Mayhew 1000 Shot Hole Drill, on contract. Owner called to service. Box D-711, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE: At Bartlesville, Oklahoma, 1 Used ELI Model M-5, Shothole Drill with 4" x 5" GD Pump, Mounted on 1945 Ford Truck $1250.00. Cities Service Oil Co., Patridge, Bartlesville, Oklahoma.

FOR SALE at our Lacy Plant, Seminole Field, 3—10'x40' Horizontal Welded and Riveted Gasoline Storage Tanks, $1500.00 each. Cities Service Oil Co., Patridge, Bartlesville, Okla.

6" OIL HOSE

SUCTION & DISCHARGE for gas or oil service 20' lengths with built-in nipples and flanges attached. New. Bargain. J. C. Martyns, 24-16 Jackson Ave., L.I. City, N.Y.

EQUIPMENT WANTED

WANTED: USED 4½" DRILL PIPE
Box D-606, The Oil and Gas Journal, Tulsa, Oklahoma.

CASING, wanted 9⅝" OD x .352" wall, #1 used. Cut 15'6" long. No coupled lengths acceptable. Torch cut ends acceptable. Advise price, origin and number of lengths available. JULIUS M. FOGELMAN, 1649 Perkiomen Ave., Reading, Penna.

WANTED: 160' of 16" OD, ¼ to 5/16" wall, PE, RL pipe. Must be good, new preferred. Judd & Son, Shullsburg, Wisconsin.

WANTED TO BUY: 16" O.D. and 10" O.D. 8 or 10 thd. 13⅜" and 9⅝" 8 thread collars, new or used. Box 574, Tulsa, Okla.

WANTED REFINERY

4,000 or 5,000 bbl. complete refinery that can be dismantled and moved export.

BEESON ENGINEERING CO.

MUtual 9151 **1628 East 7th St.**
Los Angeles 21, Calif.

WANTED

Refining Equipment used but in good condition Columns, Furnaces, Exchangers, Others.

Make specific offers to:

INDUSTRIAL OVERSEAS TECHNICAL CORP.
Mr. L. M. Jarach
120 Wall Street **New York 5, N. Y.**
Telephone DIgby 4-7850

WANTED!

Pipe Threading Machines

6", 8" and 12"

Landis or Bignall & Keeler with Landis Heads. Machines must be in good working order with individual motor drives. Give complete description including make, model and serial numbers, width of dies or chasers, motor specifications and prices.

CENTRALIA PIPE & SUPPLY CO.
Box 454—Tele. 6771
Centralia, Illinois

LEGAL BLANKS

BURKHART LEGAL BLANKS since 1908. Oil-Gas (all states), Business, Real Estate, Legal Forms, Leases, Revised With Government Regulations, Commercial Printing, Catalog and Samples on request. Burkhart Printing & Stationery Company, 115 South Cincinnati, Tulsa, 3, Oklahoma.

WANTED

WANTED: SURPLUS Chemicals, Oils, Waxes, Solvents, Wastes and Residues of all kinds. Chemical Service Corporation, 98-06 Beaver St., New York 5, N. Y.

HELP WANTED

FOREIGN and Domestic Oil Employment Directory covering the oil industry, showing where to apply for jobs. Price $5.00. Oil Industry Mailing List, Box 2603, Tulsa, Okla.

ASSISTANT GEOLOGIST for work with major oil company in Venezuela on single status, degree in geology plus two years' experience with core drill, salary commensurate with experience and ability. Give full details in reply to P. O. Box 2819, Dallas, Texas.

WANTED: Chemical Engineers for Process Design on Refining and Chemical Processes. Minimum of five years' experience in process design and familiarity with economic studies preferred. Write F. J. Heller, Research and Development Department, Phillips Petroleum Company, Bartlesville, Oklahoma.

ESTIMATOR

Experienced ENGINEER familiar with Oil Refinery design and capable of estimating process equipment from flow diagrams.

Give full information, experience record and salary expected.

ARTHUR G. McKEE & CO.
2300 CHESTER AVE.
CLEVELAND 1, OHIO

PROJECT ENGINEER

Prominent Engineering and Construction Company, located in New York City, requires Project Engineers to coordinate and direct engineering work in connection with the design and construction of petroleum and chemical plants. M.E. or Ch. E. graduate with practical petroleum refinery engineering and construction experience required. Position is permanent with excellent promotional opportunities. Detailed resume of experience and photograph desired at

Box D-688
THE OIL AND GAS JOURNAL
Tulsa, Oklahoma

WANTED

Experienced Oil Loan man for Dallas office of substantial financing firm. Man we seek might now be doing similar work for institutional lender or oil loan brokerage concern. Applicant should be between 35 and 45, preferably now residing in Texas or elsewhere in Southwest. Salary and participation basis. Good opportunity. Write in Confidence.

Box D-700, The Oil and Gas Journal, Tulsa, Oklahoma

HELP WANTED

GEOPHYSICIST with geological training. Extensive experience in seismic interpretation. Review work. Stable location. Reply Box D-706, The Oil and Gas Journal, Tulsa, Oklahoma.

JUNIOR CORROSION ENGINEER for Midwest pipe line company. Familiar with D.C. meters; B.S. in electrical or electrochemical engineering; also other pipe line jobs. Box D-697, The Oil and Gas Journal, Tulsa, Oklahoma.

TREASURER for large independent oil company. Knowledge of oil accounting and taxation essential. State experience in detail and salary expected. Box D-698, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED: Engineer familiar with Gas-fired Unit Heater design. Box D-701, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM Engineer or Geologist with experience in evaluation and subsurface studies in Gulf Coast wanted by sound independent. Age 30-45. In application state salary expected and enclose college transcript. Box D-631, The Oil and Gas Journal, Tulsa, Oklahoma.

SEISMOLOGIST for work with major oil company in Venezuela. Ten years' experience with four years interpretive work, family status, salary commensurate with experience and ability. Give full details in reply to P. O. Box 2819, Dallas, Texas.

EXPERIENCED Seismologists and Seismic Computers by large, well established geophysical company. Give full details of education and experience in letter. Reply Box D-707, The Oil and Gas Journal, Tulsa, Oklahoma.

EXPERIENCED Seismic Party Chief. Excellent opportunity. Good, sound connection. Furnish full particulars regarding experience. Reply Box D-705, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST widely acquainted in Oklahoma to trade in and develop shallow drilling deals for a group of New York independents. Salary and override to the right man. Reply Box D-709, The Oil and Gas Journal, Tulsa, Oklahoma.

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GEOLOGIST: Fourteen years major company experience desires situation with Independent concern. Box D-703, The Oil and Gas Journal, Tulsa, Oklahoma.

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CALENDAR OF EVENTS

October

American Institute of Chemical Engineers, Oklahoma meeting, University of Tulsa, Tulsa, October 7.

American Association of Oilwell Drilling Contractors, annual meeting, Mayo Hotel, Tulsa, October 9-10

National Association of Corrosion Engineers, south-central regional meeting, Rice Hotel, Houston, October 9-10.

Instrumentation for Process Industries, fifth annual symposium, Texas A. & M. College, College Station, Tex., October 11-13.

Petroleum Branch, American Institute of Mining and Metallurgical Engineers, West Coast meeting, Elks Club, Los Angeles, October 12-13.

Western Petroleum Refiners Association, regional meeting, Gladstone Hotel, Casper, Wyo., October 12-13.

West Virginia Geological Survey, conference on secondary recovery of oil in West Virginia, Morgantown, W. Va., October 13-14.

Oil Progress Week, October 16-21.

National Safety Congress, Chicago, October 16-20. Petroleum Section, October 17.

Texas Independent Producers and Royalty Owners Association, directors' meeting, San Antonio, October 18.

American Association of Petroleum Geologists, Pacific Section, Ambassador Hotel, Los Angeles, October 19-20.

Society of Economic Paleontologists and Mineralogists, Pacific Coast Section, Ambassador Hotel, Los Angeles, October 19-20.

Society of Exploration Geophysicists, Ambassador Hotel, Los Angeles, October 19-20.

Permian Basin Oil Show, Odessa, Tex., October 19-22.

Independent Natural Gas Association of America, annual meeting, Shamrock Hotel, Houston, October 23.

American Institute of Electrical Engineers' fall general meeting, Skirvin Hotel, Oklahoma City, October 23-27.

American Society of Mechanical Engineers, Fuels Division, annual joint fuels conference, Hotel Statler, Cleveland, October 24-25.

National Lubricating Grease Institute, annual meeting, Edgewater Beach Hotel, Chicago, October 30-November 1.

November

Mid-Continent Oil and Gas Association, Louisiana-Arkansas Division, annual meeting, Roosevelt Hotel, New Orleans, November 2-3.

New Mexico Geological Society, first annual conference, San Juan Basin; headquarters, Albuquerque; November 3-5.

Society of Automotive Engineers, Fuels and Lubricants meeting, Mayo Hotel, Tulsa, November 9-10.

California Natural Gasoline Association, Silver Anniversary, Los Angeles, November 9-10.

American Petroleum Institute, annual meeting, Biltmore and Ambassador Hotels, Los Angeles, November 13-16.

American Society of Mechanical Engineers, annual meeting, Grand Central Palace, New York, November 27-December 1.

Southwestern Geophysical and Geological Conference, Hotel Texas, Fort Worth, November 30-December 2.

December

American Institute of Mining and Metallurgical Engineers, annual joint meeting, Texas sections, Texas Technological College, Lubbock, Tex., December 1-2.

American Institute of Chemical Engineers, annual meeting, Columbus, Ohio, December 3-6.

Interstate Oil Compact Commission, winter meeting, Shamrock Hotel, Houston, December 11-13.

NOMADS

Tulsa Nomads, third Friday of each month. After Five Room, Tulsa Hotel.

Dallas-Fort Worth Nomads, first Monday of each month, Greater Dallas Club.

Houston Nomads, second Monday of each month. Ye Olde College Inn, Houston.

Los Angeles Nomads, second Wednesday of each month. Jonathan Club.

New York Nomads, dinner meetings, October 2 and November 6, Louis Sherry's; annual Christmas dance, December 9, Hotel Pierre.

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LEGAL

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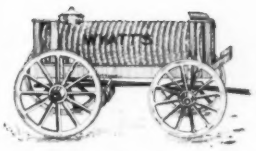

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